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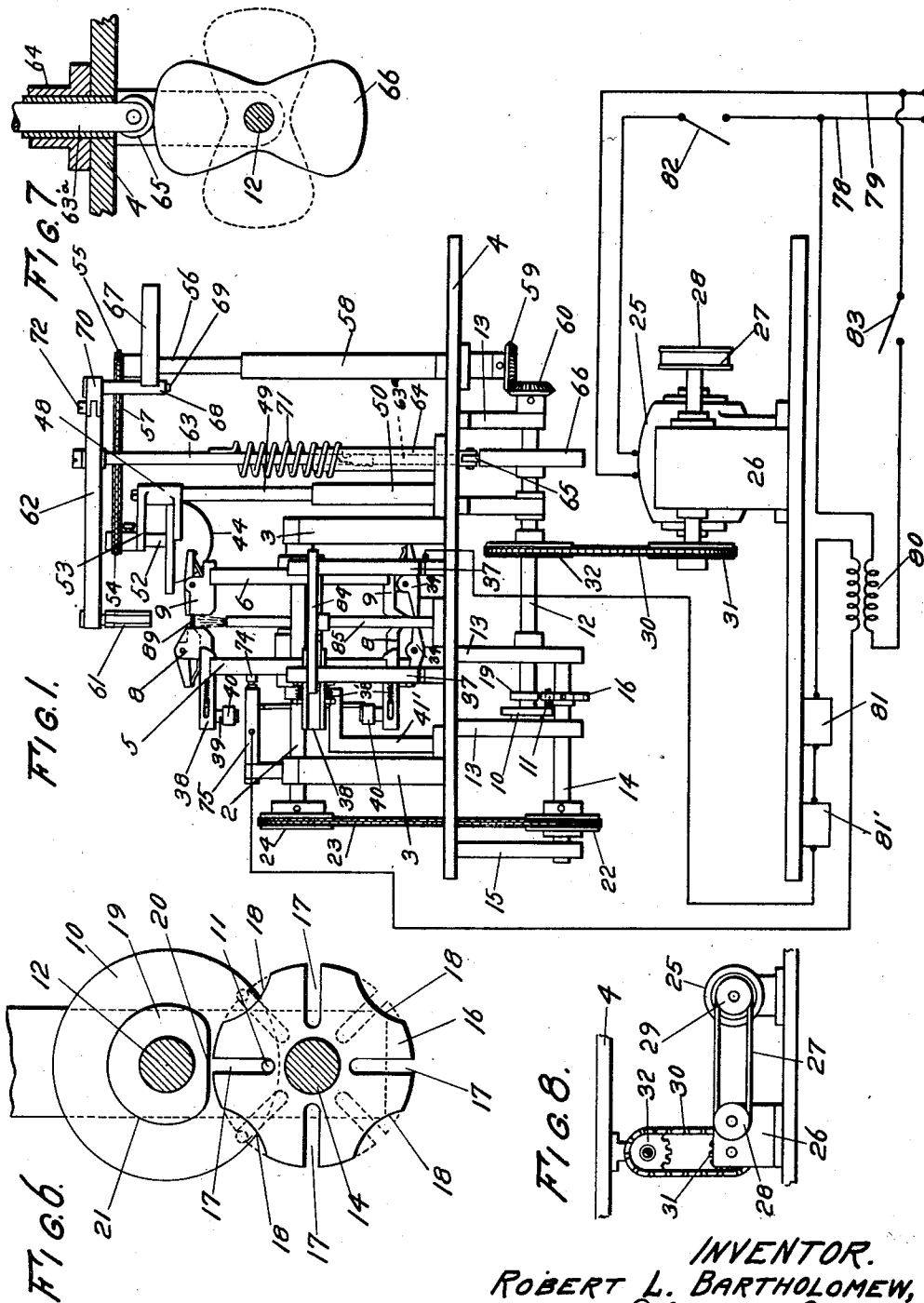
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2,432,081

COATING APPARATUS

Filed Sept. 28, 1944

3 Sheets-Sheet 1



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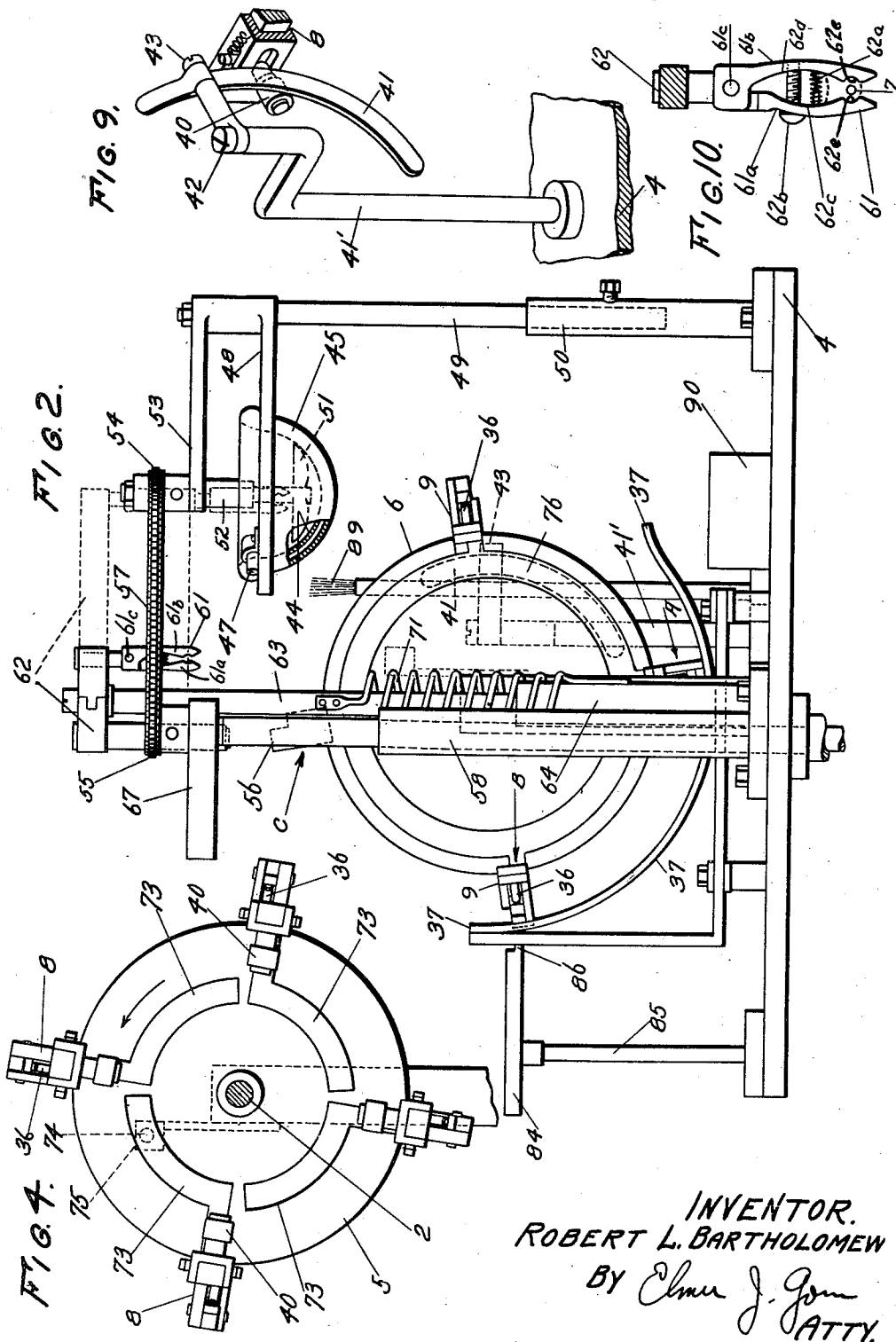
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COATING APPARATUS

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3 Sheets-Sheet 2



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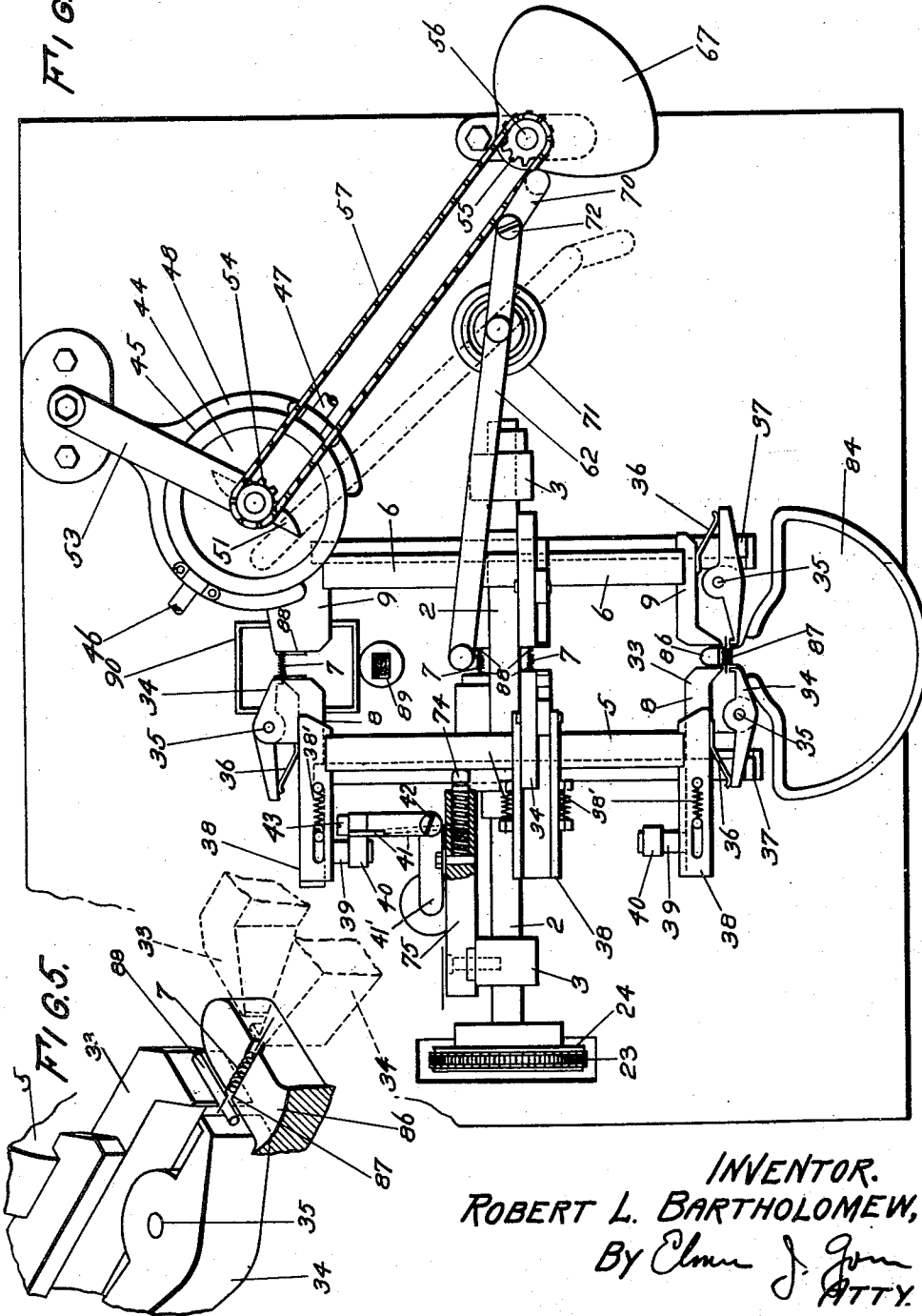
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Fig. 3.



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COATING APPARATUS

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8 Claims. (Cl. 91-17)

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This invention relates to coating apparatus, and more particularly to apparatus for coating filament coils intended for use as thermionic cathodes.

One of the objects of the invention is to provide apparatus for effecting the coating operation, thus greatly expediting and facilitating the coating operation and very materially reducing the labor cost.

Another object is to provide for the uniform coating of the article to be coated and the uniform baking of the coating applied thereto.

Another object is to provide means for controlling the viscosity of the coating material to be applied to the article.

A further object of the invention is to provide apparatus for coating filament coils.

These objects and such other aims and objects of the present invention as may hereinafter appear will be readily understood from the following description, taken in connection with the accompanying drawings of one embodiment of the invention herein presented for illustrative purposes.

In the drawings:

Fig. 1 is a front elevation of the apparatus incorporating one illustrative embodiment of the invention, and also shows diagrammatically the driving motor circuit and the heating circuit of the filament coil;

Fig. 2 is an end elevation of the apparatus shown in Fig. 1, viewed from the right side of Fig. 1;

Fig. 3 is a top plan view of the apparatus shown in Fig. 1;

Fig. 4 is a side view of the clamp carrier showing the four clamps and the four corresponding contact paths on the outside surface of said clamp carrier;

Fig. 5 is a detailed drawing, on an enlarged scale, of one of the slidably mounted clamps;

Fig. 6 is a detailed drawing of the cam mechanism for periodically rotating the clamp carriers through 90°;

Fig. 7 is a detailed drawing of the cam mechanism for lifting and lowering the coating fork;

Fig. 8 is a detailed drawing of the driving connection between the motor and the speed reduction mechanism;

Fig. 9 is a detail of the cam for stretching the filament coil; and

Fig. 10 is a detailed drawing of the coating fork.

The illustrative embodiment of the invention shown in the drawings comprises a shaft 2, jour-

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nalled in standards 3 mounted upon a frame 4.

Two discs 5 and 6 of insulating material are fixed upon said shaft 2 and constitute carrier means for seizing and holding a filament coil 7

(see Fig. 3) by its ends, such as a plurality of clamps, herein four such clamps 8 carried by disc 5 and four clamps 9 carried by disc 6, said clamps being spaced 90° apart around the periphery of said discs. The clamping end of each of the

clamps 8 upon disc 5 faces the clamping end of a corresponding clamp 9 upon the disc 6. Means are provided for rotating said discs, said means herein illustratively comprising a disc 10 provided with a laterally projecting stud 11 (see Fig. 6)

and fixed upon the main shaft 12 of the machine, journaled in suitable bearings provided in arms 13 projecting downwardly from the underside of said frame 4. A shaft 14, journaled in suitable bearings in two of said arms 13 and a third arm

15 extends parallel to said main shaft 12 below the latter and has fixed thereon a star cam 16 provided with four radial slots 17 extending inwardly from its periphery and spaced 90° apart, the edge of said cam 16 between said slots 17 being provided with curved surfaces 18 of substantially the same radius as that of a member 19 rotating with said disc 10, the construction and arrangement being such that as said disc 10 rotates said stud 11 will engage the four slots 17 in succession to rotate said shaft 14 through an angle of 90° for each complete rotation of said main shaft 12. The member 19 on said shaft 12 is provided with a straight edge portion 20 and an edge portion 21 concentric with said shaft 12 and which

successively engages said surfaces 18 on said star cam 16 to lock the latter between revolutions thereof. Said shaft 14 carries a sprocket wheel 22 which is connected by a sprocket chain 23 with a sprocket wheel 24 fixed upon one end of the aforesaid shaft 2 carrying said two discs 5 and 6 on which are mounted said clamps 8 and 9. Each pair of opposed clamps 8 and 9 will thus be advanced step by step through an angle of 90° for each complete rotation of said main shaft 12.

A motor 25 supplied with electrical energy from any suitable conventional source, such as power lines 78 and 79, drives said main shaft 12 through a suitable, conventional speed reduction mechanism 26 connected to said motor by a belt 27 passing over pulleys 28 and 29 of said motor and said speed reducing mechanism 26 respectively, and to said shaft 12 by a sprocket chain 30 passing over a sprocket wheel 31 of said speed reducing mechanism 26 and a sprocket wheel 32 fast upon said shaft 12.

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Each of the clamps 8 and 9 comprises a fixed jaw 33 and a jaw 34 pivoted upon the latter at 35 (see Fig. 3). A leaf spring 36 having one end attached to the fixed jaw 33 and the other in sliding contact with the pivoted jaw 34 tends to keep the jaws of the clamp closed.

Means are provided for opening the clamps 8 and 9 at the proper time to discharge the coated filament coil therefrom. Herein said means illustratively comprises a fixed cam 37 extending beneath each of the discs 5 and 6 concentrically with the latter and in the path traversed by the pivoted jaws of the clamps 8 and 9 in the rotation of said discs (see Figs. 2 and 3). In the rotation of said discs, the pivoted jaws of each pair of clamps 8 and 9 successively engage these cams at the proper time and separate the pivoted jaws from the fixed jaws so as to discharge the filament coil held thereby. After the discharge of the filament coil, the pivoted jaws of the two clamps of each pair remain in engagement with their respective cams 37 until in the further rotation of the said discs 5 and 6 the clamps 8 and 9 arrive at the point where they must pick up another filament coil. The pivoted jaws of the clamps then leave the said cams, and springs 36 close the pivoted jaws upon the fixed jaws to clamp the new filament at its two ends which are in position to be seized, as hereinafter more fully explained, between the open jaws. (See Fig. 3.) The clamps 9 on the disc 6 are immovably anchored in the insulating material of said disc but the clamps 8 on the disc 5 are mounted for sliding movement toward and from the corresponding clamps on said disc 6 in guides 38 which are immovably anchored in the insulating material of the disc 5. A stud 39 (see Fig. 3) attached to the movable clamp projects through a longitudinal slot in the wall of said guides 38 and carries a cam roller 40 which at the proper time in the revolution of the discs 5 and 6, while the ends of the filament coil are still clamped between the jaws of the clamps 8 and 9, engages a suitably shaped fixed cam 41 carried by an angular standard 41' mounted on the frame 4 of the machine, thus moving the clamp 8 away from its cooperating clamp 9 to stretch the filament. Springs 38' return the clamp 8 to its normal position when the stretching being completed said cam roller 40 leaves said cam 41. By loosening nuts 42 and 43 a very fine adjustment of the cam surface 41 can be effected in order to obtain just the desired amount of stretching of the filament coil. In the case of some articles, no stretching may be required, in which case said cam 41 may be adjusted in such a position that it will not contact with said cam roller 40, so that no stretching movement of said slidable clamp will occur. In the case of heavier coil filaments, for example, no stretching is necessary.

A supply of coating material, such as barium monoxide suspended in "Nujol," for example, is contained in a suitable container 44. It has been found expedient to regulate the temperature of the coating material and thus control its viscosity, and means are accordingly provided for this purpose. Said means herein conveniently comprises a jacket 45 enclosing the walls of said container. Water or other suitable liquid at the temperature desired may be supplied from a suitable supply, not shown, to said jacket through inlet 46 (see Fig. 3) and may flow out through outlet 47. Said container 44 is carried by a bracket 48 secured upon the upper end of a rod

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49 mounted in a fixed sleeve 50 carried by said frame 4.

Means may be provided gently to agitate or stir the coating material in the container 44 to keep the solid matter in suspension, said means herein illustratively comprising a double paddle 51 (see Fig. 2) immersed in the coating material and mounted upon a shaft 52 journaled in an arm 53 of said bracket 48. A sprocket 54, fast upon the upper end of said shaft 52, is conveniently driven by a sprocket 55 (see Fig. 3) rotatably mounted upon the upper end of a rod 56, by a sprocket chain 57, said rod 56 being rotatably mounted in a fixed sleeve 58, mounted upon the frame 4, the lower end of said rod 56 being operatively connected to the main shaft 12 by a right angle bevel gearing 59, 60 (see Fig. 1).

The coating material is conveyed to the coil by suitable means, such as a coating fork, herein designated generally by the reference numeral 61. Herein said coating fork (see Fig. 10) comprises two jaws 61a and 61b pivoted by a clamping pivot 61c to the end of lever 62. A helical spring 62a bears with its two ends against the jaws 61a and 61b and tends to separate said jaws, while a screw 62b, freely rotatable in jaw 61a and having screw threaded engagement with the jaw 61b, serves to adjust the spacing of said jaws from each other against the tensioned spring 62a. Means are thus provided for varying the capacity of the fork. The opposed inner surfaces 62c and 62d of the two jaws are somewhat concave and near its lower end the inner surface of each jaw is provided with a substantially semicircular recess 62e from which the inner surfaces of said jaws flare outwardly. In the operation of the device more fully described below, said coating fork 61 is first dipped quite deeply into the coating material in the container 44 so that owing to the configuration of space between the jaws of said fork, when said fork is withdrawn from said container, a substantial increment of said material, varying according to the adjustment of the spacing of the two jaws 61a and 61b will be retained in said fork, filling the space between the semicircular recesses 62e and a portion of the space above said recesses, substantially as indicated by dotted lines in Fig. 10. In order to deposit said increment of coating material upon the filament coil, said fork is lowered until its two jaws embrace the filament between the two semicircular recesses 62e whereupon the coating material in the fork will adhere to and completely immerse the filament coil. The operating mechanism of said coating fork herein illustrated comprises a two-armed lever 62 of which the longer arm carries said coating fork 61 and is fixed upon the upper end of a rod 63 rotatably and slidably mounted in a vertical sleeve 64 mounted upon said machine frame 4. The rod 63 extends for a sufficient distance into the sleeve 64 to be guided thereby in all positions thereof and contacts at its lower end a rod 63a slidably but non-rotatably mounted in said sleeve 64. Said rod 63a carries a cam roller 65 which rests upon the edge of a butterfly cam 66 fast upon said main shaft 12, and serves to raise and lower said rod 63 and coating fork 61 at the proper intervals. Adjacent its upper end, the above-mentioned rod 56 has fast thereon a cam 67 which is in operative engagement with a cam sleeve 68 rotatably mounted upon a stud 69 carried by the shorter arm 70 of said two-armed lever 62. A helical spring 71 surrounding said rod 63 and connected at one end to said rod 63 and at the other end to said

fixed sleeve 64 tends to keep said cam sleeve 68 in contact with the edge of said cam 67, so that in the continuous rotation of said main shaft 12, said two cams 66 and 67 will cooperate to actuate said coating fork 61 at the proper time to convey coating material to the filament coil, said cam 66 raising and lowering said coating fork to pick up coating material from said container 44 and discharge it upon the filament coil, and said cam 67 swinging said coating fork back and forth alternately from a position above said container where it can be lowered into said container and raised thereupon by said cam 66, and then into a position above the filament coil where said cam 66 can lower it to deposit its load of coating material upon said filament coil, and then raise it to be moved back over the container 44 by said cam 67.

The shorter arm 70 of said two-armed lever 62 will preferably be adjustably connected to the longer arm of said lever by a clamping screw 72 for adjustment to vary the throw of said lever (see Fig. 3).

In accordance with the present invention, means are provided for heating the filament coil to bake the coating thereon, said means herein conveniently comprising four separate electric contact paths 73 on the outer lateral surface of one of said discs 5 and 6, the disc 5, for example, and each of the clamps 8 carried by said disc is electrically connected to one of said contact paths, which are concentric with said disc 5. A spring pressed contact brush 74 slidable in an insulating arm 75 mounted upon standards 3 will contact with each of said contact paths 73 in succession as said discs 5 and 6 rotate. The other disc 6 is provided upon its outer lateral surface with a circular contact path 76 concentric therewith and electrically connected with each of the clamps 9 carried by said disc 6 (see Fig. 2). One of the clamps 9 on the disc 6 will always be in contact with the cam 37 under said disc, so that all the clamps on said disc 6 will always be electrically connected to said cam.

The circuit for heating the filament coil may be supplied with energy from any suitable conventional source, such as the power lines 78 and 79 (see Fig. 2). Said circuit comprises a transformer 80, a rheostat 81, an ammeter 81' and two switches, one 82 for the motor circuit and the other 83 for the heating circuit proper. One terminal of said heating circuit is connected to the contact brush 74 and the other to the cam 37 which opens the clamps on disc 6. When in the rotation of discs 5 and 6, one of the contact paths 73 of the disc 5 contacts with the contact brush 74, the circuit for heating the filament coil will be closed through said contact brush 74, contact path 73 on disc 5 with which said brush is in contact, the corresponding clamp 8, holding one end of the filament coil, clamp 9 on disc 6, holding the other end of said filament coil, contact path 76 on said disc 6, and finally through some other clamp 9 on said disc 6 that is in contact with said cam 37.

A plate 84 is suitably supported at the front of the machine upon a standard 85 mounted upon the frame 4 (see Figs. 2 and 3). Said plate is provided with a tongue 86 extending forwardly between the clamping ends of the clamps 8 and 9 when these are in position to seize the filament coil by its ends (see Figs. 3 and 5). In the upper surface of said tongue 86 there will preferably be provided a shallow, transverse slot 87 (see Figs. 3 and 5) to receive each filament coil

to be presented to said clamps. The construction and arrangement are such that when clamps 8 and 9 move into position to clamp the filament coil by its ends, said ends will project between the two jaws of said clamps which are open to receive them. Means may be provided, such as a thin rod 88 carried by the fixed jaw of each clamp and extending across the opening between the two jaws in such a position that when the clamps are in position to seize the ends of a filament coil, said ends will rest upon said rods in position to be clamped between the open jaws. (See Fig. 5.) A brush 89 may be mounted on the frame in the path of the filament coil, so that said brush 89 meeting said filament coil, as the latter is carried along by said clamps, will remove any excess coating material therefrom.

The apparatus operates as follows, it being understood that the cycle of operation is identical for each pair of clamps 8 and 9, so that a description of the cycle of operation of one pair of said clamps will suffice.

With a pair of clamps 8 and 9 in the position A in Fig. 2, if switches 83 and 82 be closed, the disc 10 will impart a quarter revolution to the star cam 16 and hence to the two discs 5 and 6, thus rotating the pair of clamps from the position A to position B, whereupon said discs 5 and 6 and a pair of clamps come to rest and remain at rest while said disc 10 completes its revolution. During this movement of said pair of clamps the pivoted jaws of said two clamps have been in contact with their respective cams 37, the jaws of said clamps thus remaining open.

In the continued rotation of shaft 2 and said disc 10, the stud 11 now engages the next slot 17 of star cam 16 and rotates it and the discs 5 and 6 through a further 90°, said pair of clamps thus arriving at the position C, when they come to rest again. During this further quarter revolution from position B to position C, the pivoted jaws of clamps 8 and 9 leave their cams 37, thus allowing springs 36 to close the jaws of said clamps to seize the ends of the filament coil resting upon the rods 88 between said jaws. In the meantime the cams 66 and 67 have cooperated, as previously described, to move the coating fork 61 to convey an increment of coating material from the container 44 and deposit it upon the filament coil while it is in the position C. At the start of the next quarter revolution of said discs from position C to position D, the leading end of contact path 73 with which clamp 8 on disc 5 is electrically connected, contacts with the yielding contact brush 74 and the heating current starts to flow through the filament coil held by said clamps 8 and 9 to heat the filament coil and bake the coating thereon, said contact brush remaining in contact with said contact path 73 approximately during the remainder of this quarter revolution, the length of said contact path 73 and the timing being such that the heating of the filament coil will preferably continue for from 5 to 6 seconds. During this quarter revolution of said discs 5 and 6 also, the coated filament coil meets the brush 89 which removes any excess coating material from said filament coil, and the cam roll 40 on the slidable clamp 8 starts along the cam 41 and is thus moved away from clamp 9 and stretching of the filament coil is initiated, and continues approximately to the end of said quarter revolution, when said roll 40 leaves said cam 41, and the pivoted jaws of clamps 8 and 9 pass onto their cams 37, thus opening said clamps

and dropping the coated, baked and stretched filament coil into a suitable receptacle 90. During the following two quarter revolutions of said discs 5 and 6 through position A to position B, the pivoted jaws of the two clamps 8 and 9 remain in contact with their cams 37, as above stated, thus keeping said jaws open to be ready to receive the ends of another filament ready upon the tongue 86 of plate 84, and the cycle above described is repeated.

The present invention marks an important and useful advance in the art. By executing mechanically operations heretofore done by hand it effects a saving of approximately 90% in labor cost alone. The filament coils are uniformly coated, stretched and baked. Such uniformity of coating, stretching and baking of filament coils was impossible of attainment by hand. Uniformity of coating, however, is important as it makes for a more even and efficient emission by the filament. Similarly uniform stretching is a great advantage as the filament coils will thus extend in a straight line between their supports in the tube; there will be no sagging to influence the field distribution and cause objectionable capacity effects. Uniformity of baking is also important as it enhances the efficiency and durability of the filament coil.

Wherever the word plurality occurs in the claims, it is to be understood as meaning two or more.

I am aware that the present invention can be embodied in other specific forms without departing from the spirit and essential attributes thereof, and I therefore desire the present description to be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the aforesaid description to indicate the scope of the invention.

What is claimed is:

1. In coating apparatus, means for applying coating material to an article to be coated, means for seizing an article to be coated, means for actuating said seizing means to seize an article to be coated and to release said article when coated, means for moving said coating applying means relatively to said seizing means to apply coating material to the article seized thereby, and means for rendering said seizing means operative to stretch said article seized thereby.

2. In apparatus for coating filament coils, supply means containing a supply of coating material, conveying means for conveying coating material from said supply means and depositing it upon a filament coil to be coated, actuating means for said conveying means, clamps for seizing said filament coil by its ends, means for actuating said clamps to seize said filament coil to be coated by its ends and to release said filament coil when coated, a rotary carrier carrying said clamps and adapted in its rotation to render said means for actuating said clamps operative, and means for rotating said carrier to bring said clamps into position to seize the ends of said filament coil to be coated and to render said means for actuating said clamps operative to cause said clamps to seize the ends of said filament coil to be coated and to release the coated filament coil.

3. In apparatus for coating filament coils, supply means containing a supply of coating material, conveying means for conveying coating material from said supply means and depositing it upon a filament coil to be coated, actuating means for said conveying means, separate clamps for seizing said filament coil by its ends, means for

actuating said clamps to seize said filament coil by its ends and to release said filament coil when coated, a rotary carrier carrying said clamps and adapted in its rotation to render said means for actuating said clamps operative, a contact path on said carrier in the arc of a circle of predetermined length concentric with said carrier, a fixed contact for contacting with said contact path in the rotation of said carrier and electrically connected to one of said clamps, the other clamp and said fixed contact being in circuit with a suitable source of electrical energy, and means for rotating said carrier to bring said two clamps into position to seize the ends of said filament to be coated, and to render said actuating means for said clamps operative to cause said clamps to seize the ends of said filament coil to be coated and to release the coated filament coil, and to bring said contact path in contact with said fixed contact to close the circuit through the coated filament coil while held between said clamps, to heat said filament coil and bake the coating thereon.

4. In apparatus for coating filament coils, supply means containing a supply of coating material, conveying means for conveying coating material from said supply means and depositing it upon a filament coil to be coated, actuating means for said conveying means, separate clamps movable relatively to each other, means for actuating said clamps to seize said filament coil by its two ends and to release said filament coil when coated, means for moving said clamps relatively to each other, a rotary carrier carrying said clamps and adapted in its rotation to render said means for actuating said clamps operative, and means for rotating said carrier to bring said clamps into position to seize the ends of said filament coil, to render said actuating means of said clamps operative to cause said clamps to seize the ends of said filament coil to be coated and to release the coated filament coil, and to render said means for relative'y moving said clamps operative to stretch the filament coil held between them.

5. In apparatus for coating filament coils, supply means containing a supply of coating material, conveying means for conveying coating material from said supply means and depositing it upon a filament coil to be coated, actuating means for said conveying means, clamps for seizing said filament coil to be coated by its ends, means for actuating said clamps to seize said filament coil by its ends and to release said filament coil when coated, means for presenting a filament coil to be coated to said clamps in position for the latter to seize its ends, a rotary carrier carrying said clamps and adapted in its rotation to render said means for actuating said clamps operative, and means for rotating said carrier to bring said clamps into position to seize the ends of said filament coil to be coated and to render said means for actuating said clamps operative to cause said clamps to seize the ends of said filament coil to be coated and to release the coated filament coil.

6. In apparatus for coating filament coils, supply means containing a supply of coating material, conveying means for conveying coating material from said supply means and depositing it upon a filament coil to be coated, actuating means for said conveying means, clamps for seizing said filament coil by its ends, means for actuating said clamps to seize said filament coil to be coated by its ends and to release said filament coil when coated, means for removing excess coating material from said filament coil, a rotary

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carrier carrying said clamps and adapted in its rotation to render said means for actuating said clamps operative, and means for rotating said carrier to bring said clamps into position to seize the ends of said filament coil to be coated, to render said means for actuating said clamps operative to cause said clamps to seize the ends of said filament coil to be coated and to release the coated filament coil, and to render said means for removing excess coating material from said filament coil operative.

7. In apparatus for coating filament coils, supply means containing a supply of viscous coating material, conveying means for conveying coating material from said supply means and depositing it upon a filament coil to be coated, actuating means for said conveying means, clamps for seizing said filament coil by its ends, means for actuating said clamps to seize said filament coil to be coated by its ends and to release said filament coil when coated, means for regulating the temperature of said coating material to control the viscosity of said coating material, a rotary carrier carrying said clamps and adapted in its rotation to render said means for actuating said clamps operative, and means for rotating said carrier to bring said clamps into position to seize the ends of said filament coil to be coated and to render said means for actuating said clamps operative to cause said clamps to seize the ends of said filament coil to be coated and to release the coated filament coil.

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8. In an apparatus for coating filament coils, supply means containing a supply of liquid coating material, means for applying coating material to a filament coil, said means comprising a coating fork having a pair of arms spaced to provide a pocket in which coating material may be carried, means for dipping said arms into said supply of coating material whereby some of said coating material passes into and is retained in said pocket, said last-named means being adapted to move said fork out of said supply and into coating engagement with said filament coil whereby said coating material contained in said pocket is transferred to said coil.

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