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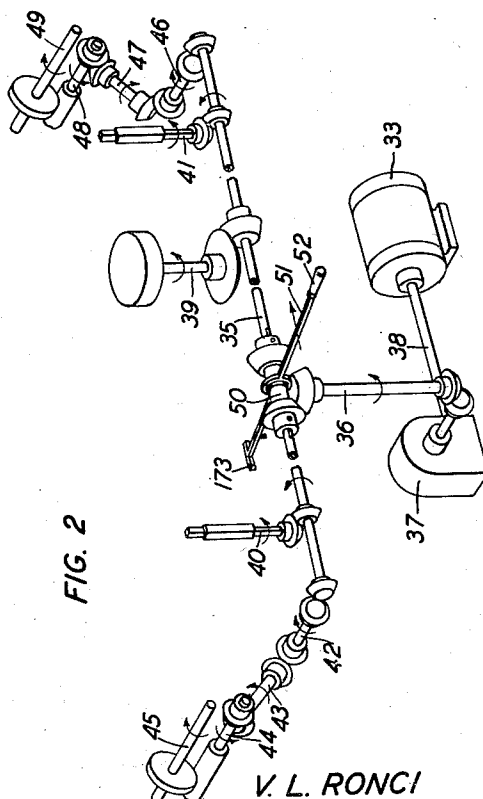
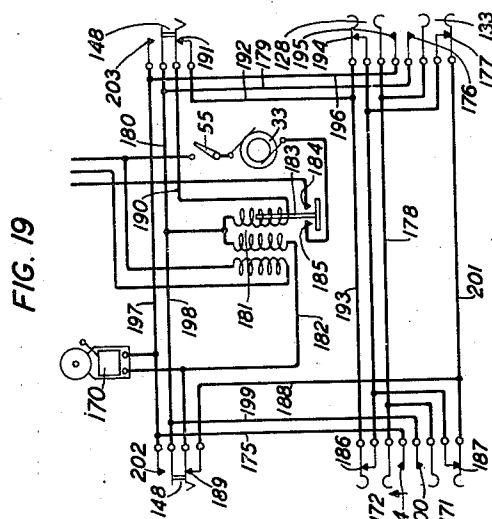
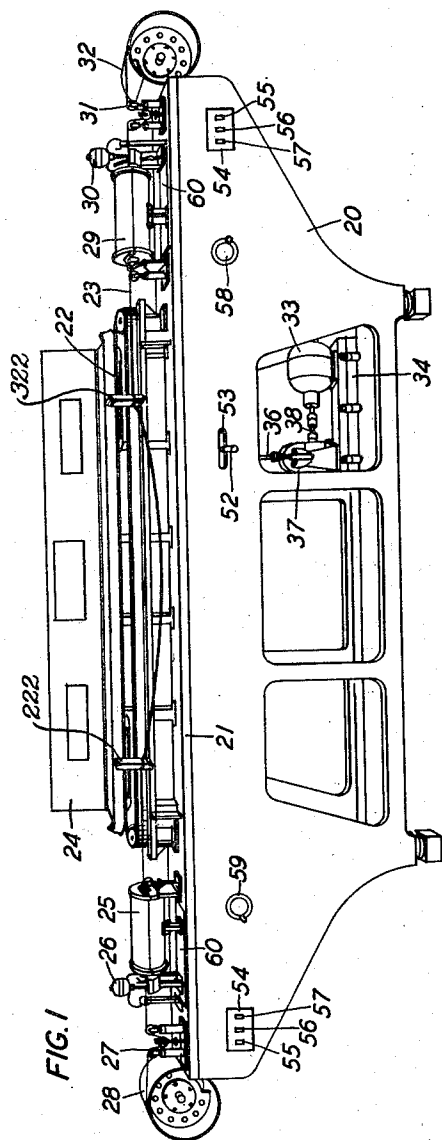
V. L. RONCI ET AL

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APPARATUS FOR COATING ELECTRICAL CONDUCTORS

Filed April 5, 1932

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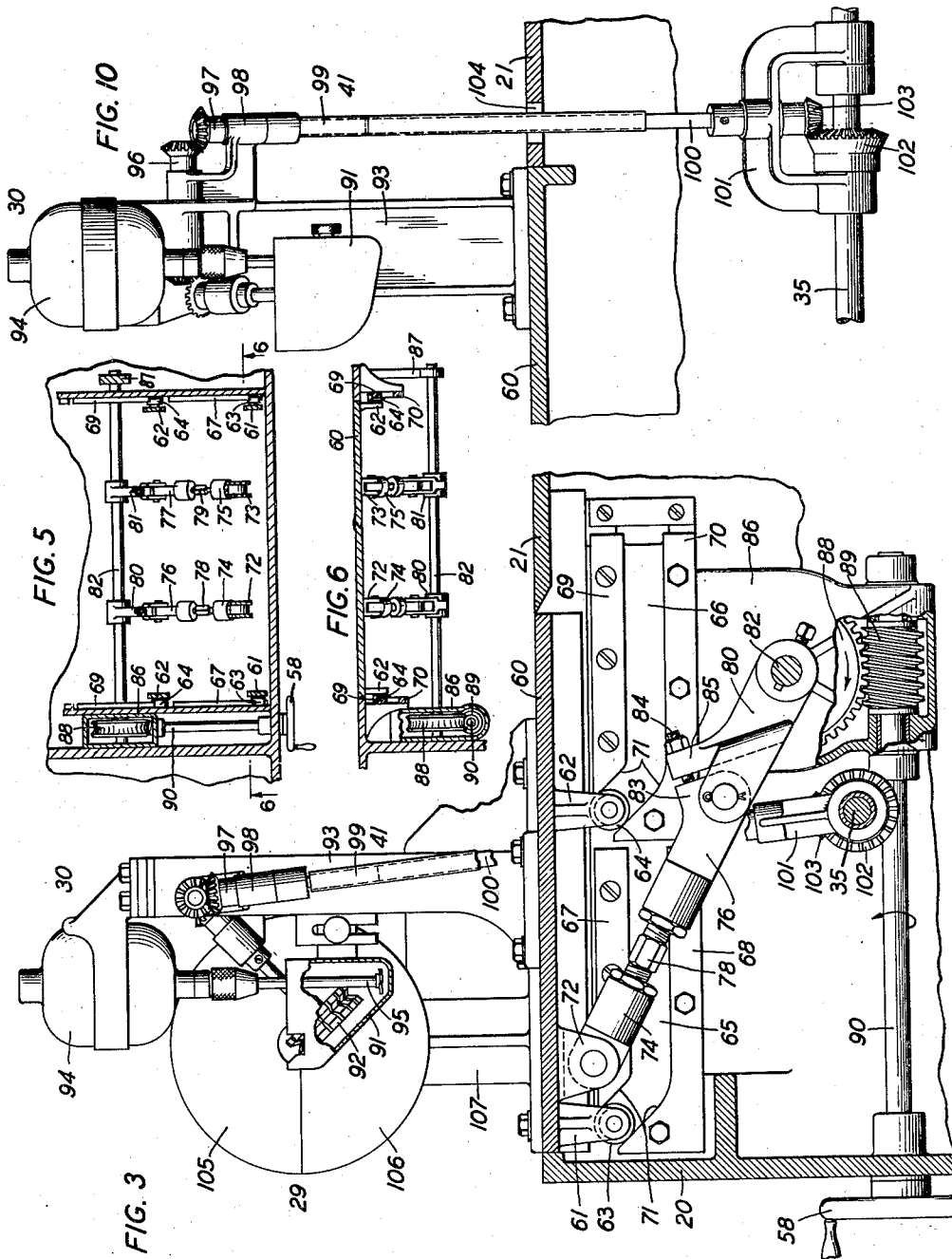
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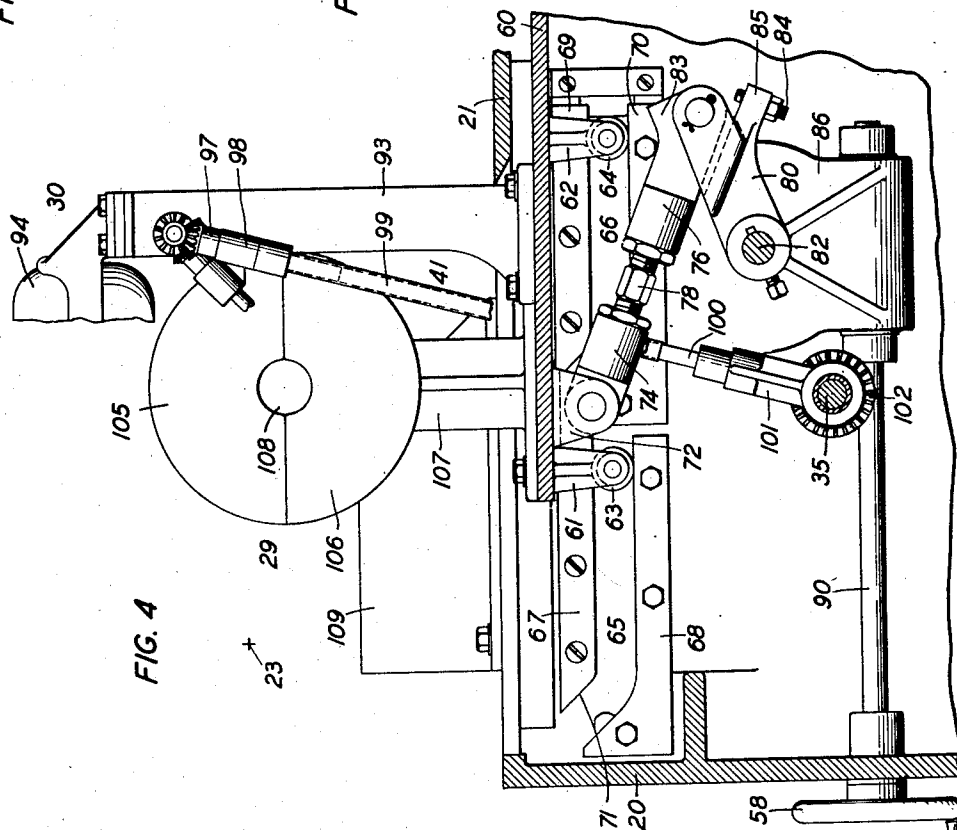
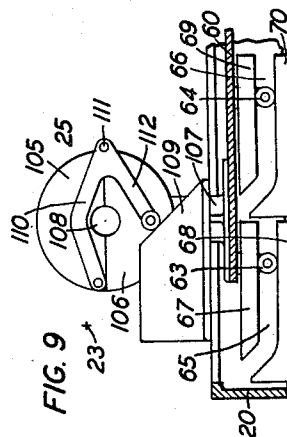
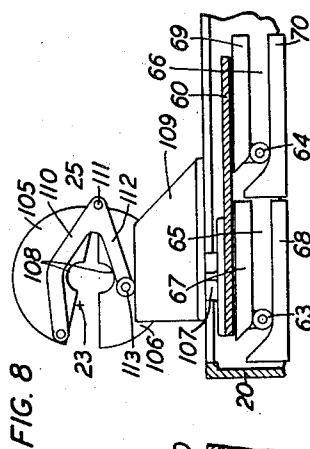
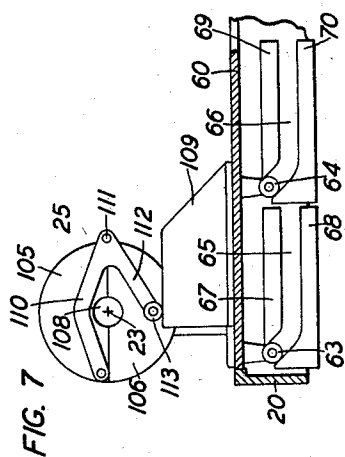
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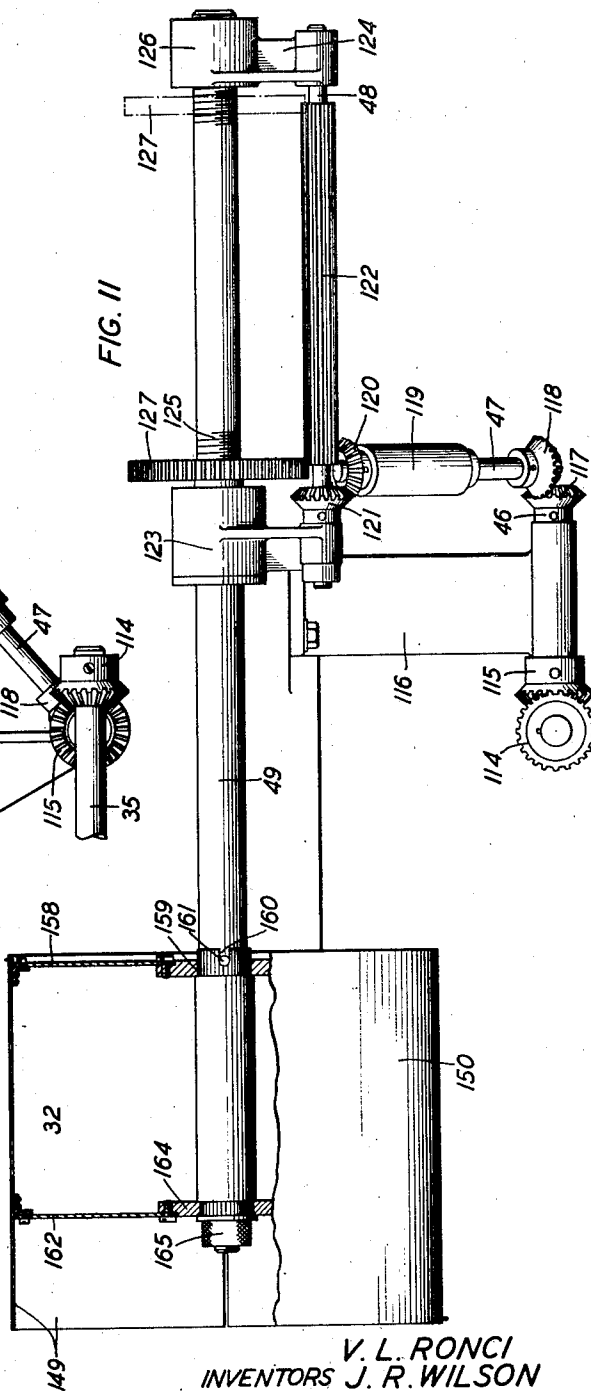
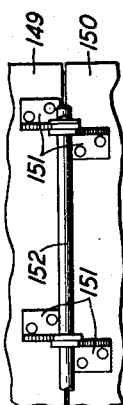
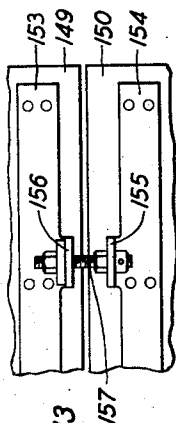
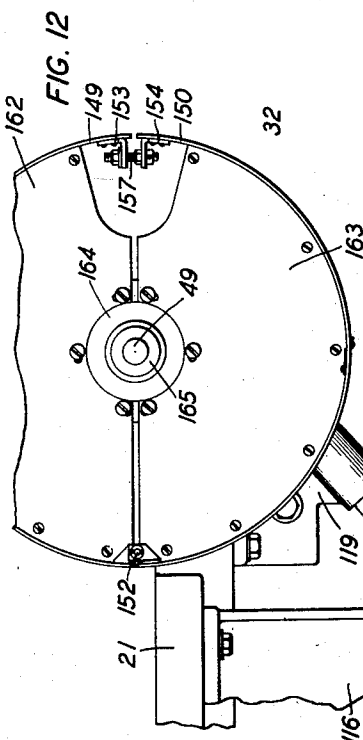
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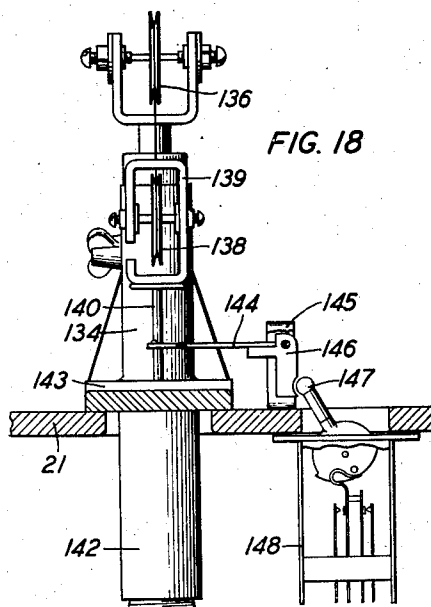
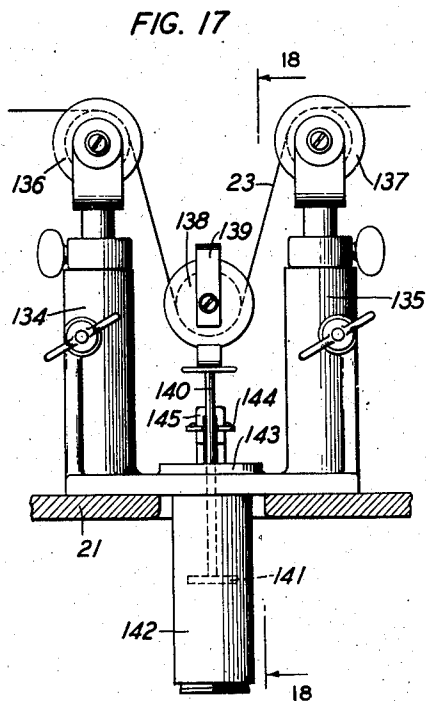
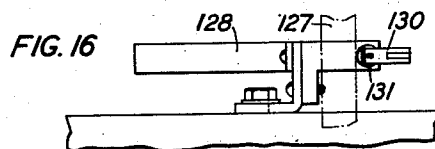
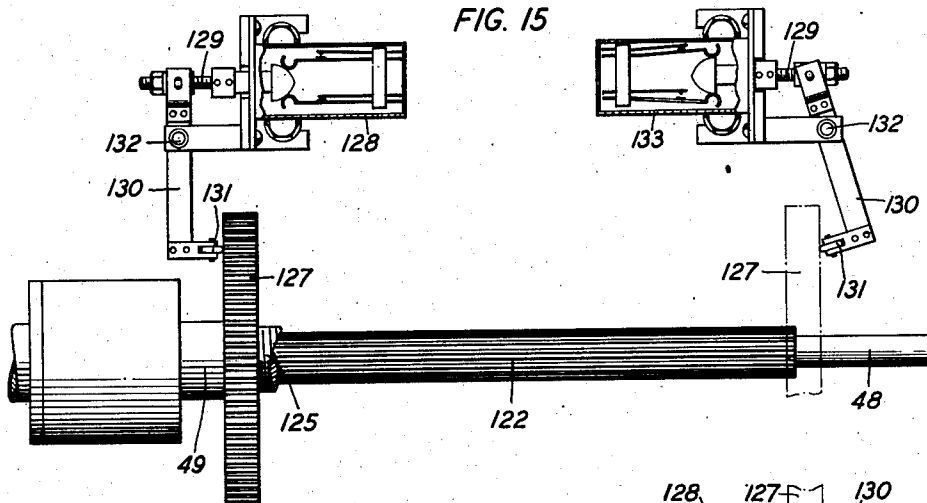
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UNITED STATES PATENT OFFICE

1,986,534

APPARATUS FOR COATING ELECTRICAL CONDUCTORS

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Application April 5, 1932, Serial No. 603,426

19 Claims. (Cl. 91—55)

This invention relates to apparatus for coating electrical conductors and has particular reference to coating of filament material such as is used for electron emitters in electric discharge devices.

The general object of the invention is to apply a coating material to electrical conductors in a continuous process in opposite directions of travel of the conductor through the machine.

A specific object of this invention is to increase the rate of production of coated filaments and to insure a uniform coating of active material on the filament.

This invention is an improvement of the coating apparatus disclosed in a copending application, Serial No. 384,376, filed August 8, 1929, and entitled "Method and apparatus for coating filamentary material".

In the above application the filamentary material is wound on a supply drum and passes successively through a coating receptacle, baking oven, a flash conveyer frame and is finally wound upon a take-up drum to complete one cycle of operation for forming a coating of thermionically active material on the filamentary material. In order to apply successive coatings of thermionically active material to the filamentary material, the filament travels in opposite directions between the supply drum and the take-up drum. In the direction of travel from the take-up drum to the supply drum a similar coating receptacle and a baking oven are positioned between the take-up drum and the conveyer frame and during this interval of operation the coating receptacle and baking oven intermediate the supply drum and the conveyer frame are removed from their operative positions.

In accordance with this invention, the coating receptacles and baking ovens on opposite sides of the conveyer frame are mounted on movable carriers which may be transferred to remove or replace the baking ovens and coating receptacles with respect to the line of travel of the coated filamentary material.

A feature of this construction is the provision of automatic means for opening and closing the baking oven which surrounds the filamentary material.

Another feature of the invention relates to automatic means for disconnecting the power source from the rotating drums when the filamentary material is broken during transit. This arrangement consists of a suspension element carried on the filamentary material between roller guides, the suspension element dropping by gravity when the material is broken and engaging a trip lever

which actuates a key or switch connected to the motor control circuit.

Another feature of the invention relates to automatic disconnection of the motor from the rotating drums when the filamentary material has been unwound from either drum. This arrangement comprises spaced discs on a rotating shaft of one drum which advance into position to actuate switching mechanisms to disconnect the motor from the drum when the limit of travel of the filamentary material in either direction is reached. The switching mechanism also rings an alarm to inform the operator to reverse the operation of the machine to apply a successive coating of material to the filament.

Another feature of the invention resides in the provision of telescopic driving members connected between the power source and the coating units whereby these units are continuously connected to the power source in either position of the movable carrier. This arrangement consists of a swinging yoke carried by the main drive shaft which supports the rotating shaft coupled to the coating unit. This shaft is formed of two telescoped sections to permit the shaft to apply rotating movement to the coating unit when it is in operative or idle position.

A further feature of the invention relates to the provision of adjustable drums on which the filamentary material is wound, to insure that the distance between gripping points on the conveyer frame does not vary to any substantial extent, thereby reducing the wastage of the filament due to the contact of the filament with the gripping elements on the conveyer frame.

These and many other features of the invention will be more clearly understood from the following detailed description taken in connection with the accompanying drawings which are represented as follows:

Fig. 1 illustrates the complete assembly of the machine embodying all the features of this invention;

Fig. 2 shows in perspective in a diagrammatic way the main drive shaft connected to the motor source and the various mechanisms of the machine of Fig. 1;

Fig. 3 is an end view partly in cross-section showing the mechanism for manipulating the movable carrier supporting the baking oven and coating unit and this figure shows the carrier in its operative position;

Fig. 4 is a similar view of the movable carrier in its retracted position;

Fig. 5 is a sectional top view of the movable

carrier showing the relation of the various elements for transferring the carrier;

Fig. 6 is a cross-sectional view of the carrier of Fig. 5 on the line 6—6;

5 Figs. 7, 8 and 9 show the various positions of the baking oven mounted on the movable carrier and illustrate the means for automatically opening and closing the oven during the movement of the carrier;

10 Fig. 10 is a front view of the coating unit supported on the movable carrier and the connection of this unit to the main drive shaft and also shows the telescopic drive shaft between the main drive and the coating unit;

15 Fig. 11 is a side view of the rotating drum and the driving mechanism for progressively advancing the drum to wind the filamentary material thereon in a single layer;

20 Fig. 12 is an end view of the drum and driving mechanism illustrating the assembly of the drum;

25 Figs. 13 and 14 are partial views of the couplings on opposite sides of the drum as shown in Fig. 10 showing the means for adjusting the periphery of the drum;

Fig. 15 illustrates the assembly of the drum drive and the circuit controlling keys for disconnecting the motor at the end of each cycle of coating operation;

30 Fig. 16 is a partial view of the mounting of one of the circuit controlling keys on the machine in relation to the stop member on the drum drive shaft;

35 Fig. 17 is an enlarged view of the guide unit for the filamentary material showing the suspended element between the stationary guides;

Fig. 18 is a side view of Fig. 17 on the line 18—18 showing the relationship of the suspended element with respect to the trip lever and key; 40 and

45 Fig. 19 is a schematic view of the circuit for ringing the alarm and disconnecting the motor source from the various driven elements of the machine when the filamentary material is broken or the complete cycle of coating operation is ended.

In the drawings, Fig. 1 shows a complete coating machine embodying the same series of mechanisms or units as described in the copending application mentioned above. These units are 50 mounted in cooperative relation on an elongated bench, table or base 20 having a substantially flat bed-plate 21, which extends horizontally along the full length of the base 20. The central area 55 of the bed-plate supports a continuous conveyer frame unit 22 for automatically flashing sections of the coated conductor 23 after they leave either of the coating units and baking ovens positioned on opposite sides of the conveyer frame. 60 The term "conductor" is intended to represent a fine filament, ribbon, strand or wire of ordinary gauge which is adapted to be coated with a protective, insulating or thermionically active covering. The conveyer frame 22 is shown in exposed condition with the cover plate 24 raised 65 in order to illustrate the general construction of the conveyer frame. However, the conveyer frame is shown only in skeleton form since a complete and detailed description of this frame is contained in the copending application mentioned above. A baking oven 25 and a coating unit 26 are positioned on the left-hand side of the conveyer frame 22 as viewed in Fig. 1. These units are followed by a guide assembly 27 positioned on the end of the bed-plate 21 and a

drum 28 extends over the end of the bed-plate 21. Similarly, on the right-hand side of the conveyer frame as viewed in Fig. 1 is a baking oven 29 and a coating unit 30 followed by a guide assembly 31 on the end of the bed-plate 21 and the complete assembly terminates in a drum 32 extending beyond the edge of the bed-plate 21. 5

During the alternate travels of the filamentary material for applying successive coatings of thermionically active material thereto and flashing 10 the filamentary material after each application of coating material, the drums 28 and 32 alternately serve as supply reel and take-up reel depending on the direction of travel of the filamentary material during each cycle of operation of the machine. 15 Consequently, after each cycle of operation is completed the rotation of the drums must be reversed in order to apply a successive coating of thermionically active material to the filamentary material. This is accomplished in accordance 20 with this invention by a main drive shaft located below the bed-plate 21 and enclosed in the base 20. The main drive shaft is driven from a single source of power such as motor 33 supported on a sub-base 34 located below the bed-plate 21 and 25 within the lower portion of the base 20. A clearer understanding of the means for driving the various units of the machine and the reversal of the movements of the elements will be obtained from a description of the diagrammatic showing of the 30 driving mechanism in Fig. 2. A main drive shaft 35 is supported horizontally below the bed-plate 21 and is coupled to the driving motor 33 by a vertical shaft 36, reduction gear unit 37 and horizontal shaft 38. The shaft 35 drives the conveyer 35 frame through meshed gears and the vertical shaft 39 and the coating units 26 and 30 through meshed gears and the swinging shafts 40 and 41, respectively. The drum 28 is driven from the main drive shaft by coupling shafts 42, 43, 44 and 40 45 and the drum 32 is driven from the main shaft by coupling shafts 46, 47, 48 and 49. The rotation of the main drive shaft 35 is reversed by the reversing gear assembly 50 which comprises two opposed bevel gears connected by an intermediate 45 collar and slidable in a keyway on the main drive shaft 35. The shifting of either bevel gear into engagement with the gear carried by vertical shaft 36 is accomplished by a shift bar 51 having a handle 52 extending through a slot 53 in the front 50 of the base 20 so that the shift bar may be operated by the attendant or operator when necessary. Adjacent each end of the machine is a template 54 on which is mounted three switches 55, 56 and 57 55 for starting the machine, starting the upright motors on the coating units 26 and 30 and completing the circuit for heating the resistance unit in the baking ovens 25 and 29 respectively. This arrangement permits an operator to control the machine from either end. 60

When the filamentary material 23 is wound on the drum 28, serving as a supply reel, and passed through the coating unit 26 and oven 25, the coated filament is engaged by traveling grippers 222 and 322 on the conveyer frame to flash the 65 section of filament held between these grippers and when released is wound on the drum 32 which serves as a take-up reel. During this cycle of operation, the baking oven 29 and the coating unit 30 are inactive. Similarly, when the travel 70 of the filamentary material 23 is in the opposite direction, for instance when the drum 32 serves as a supply reel and the drum 28 as a take-up reel, the filamentary material is coated and baked by the coating unit 30 and the baking oven 29 and 75

during this cycle of operation the baking oven 25 and coating unit 26 are inactive.

In order to facilitate the transfer of the respective coating units and baking ovens into operative position or inactive position or conversely, in accordance with this invention, each coating unit and baking oven is mounted on a movable carrier or transfer table which may be actuated by a hand wheel adjacent each of the baking oven positions. For instance, at the start of the cycle of operation from supply reel 28 to take-up reel 32 the baking oven 29 and coating unit 30 will be transferred to an inactive or retracted position by the operation of hand wheel 58 which extends from the front of the base 20 adjacent the baking oven 29. Similarly, before the start of the coating operation from supply reel 32 to the take-up reel 28 the hand wheel 58 will be operated to advance the baking oven 29 and coating unit 30 to an operative position and the baking oven 25 and coating unit 26 will be transferred to an inactive position by operation of hand wheel 59 which projects from the front of the base 20 adjacent the baking oven 25.

In order to understand how the operations are performed and the mechanism for transferring the carrier to either position, automatically opening the baking oven and removing the coating unit without injury to the filament, reference is made to Figs. 3 to 9, inclusive, which illustrate in detail the various elements entering into the transfer of the carrier into its operative and inactive positions.

Referring to Figs. 3 and 4 the transfer table or movable carrier supporting the baking oven and coating unit consists of a rectangular plate 60 which, in its normal operative position, completely closes an opening in the bed-plate 21 and lies in the same plane as the bed-plate. The plate 60 is supported in position by two pairs of cast journal posts 61 and 62 projecting from the lower surface of the plate 60, the posts carrying outside rollers 63 and 64 positioned in successive guideways 65 and 66 formed by pairs of parallel rails or tracks 67, 68, 69 and 70, respectively. It will be noted from Figs. 5 and 6 that the forward pair of journal posts 61 are positioned on opposite edges of the front of the plate 60. A similar pair of journal posts 62 are mounted in an intermediate position along the sides of the plate 60 and parallel to the journal posts 61 as shown in Figs. 3 and 4. The tracks or rails 67 to 70, inclusive, are provided with forwardly inclined surfaces 71 to form an initial downwardly sloping guideway for the rollers 63 and 64, the function of which will be described in connection with the operation of the carrier.

Two pairs of trunnions 72 and 73 are also cast on the lower surface of the carrier plate 60 and spaced a suitable distance from the center of the plate 60 but set back from the journal posts 61. These trunnions carry or support buckle members 74 and 75 which are pivoted to the trunnions. Cooperating buckles 76 and 77 are connected to the buckles 74 and 75, respectively, by turn screws 78 and 79 to form the thrust arms for moving the carrier and permitting adjustment of the length of the arms to compensate for wear of the parts. The cooperating buckles 76 and 77 are pivoted to rigid arms 80 and 81 secured to a shaft 82. Each of the cooperating buckles 76 and 77 is provided with a stop surface 83 which is engaged by a set screw 84 extending through a projection 85 on the rigid arms 80 and 81. This adjustment limits the forward travel of the carrier plate 60 and always maintains the surface of the

carrier in the same plane as the bed-plate 21. The shaft 82 is supported in a journal housing 86 on one side and a journal plate 87 on the other side, the journal housing and plate being rigidly fastened to the lower surface of the bed-plate 21. A gear 88, attached to one end of the shaft 82 within the journal housing 86 engages a worm gear 89 carried by an outwardly extending shaft 90 which is coupled to the hand wheel 58 on the front of the base 20. The carrier 60 is transferred from its operative position as shown in Fig. 3 to its retracted or idle position as shown in Fig. 4 by rotating the wheel 58 in a counter-clockwise direction to impart rotation of the gear 88 in a clockwise direction through the engagement with the spiral gear 89. The rotation of the gear 88 on the shaft 82 moves the rigid arms 80 and 81 through an arcuate path in a right-hand direction to a position as shown in Fig. 4. Since the arms 80 and 81 are connected to the turn buckle thrust arms coupled to the carrier 60, the travel of the arms 80 and 81 in an arcuate path propels the carrier from its active position, as shown in Fig. 3, to its idle position, as shown in Fig. 4. When it is desired to return the carrier to its operative position, the hand wheel 58 is rotated in a clockwise direction and this movement causes rigid arms 80 and 81 to traverse a return arcuate path to propel the carrier, through the linkage of the thrust arms, to its operative position.

During the initial turning of the hand wheel 58 to transfer the carrier 60 from its operative to an inactive position, the rollers 63 and 64 travel downwardly on the inclined surfaces 71 of the upper and lower tracks or rails 67, 68, 69 and 70. This inclined travel of the rollers causes the carrier 60 to be lowered below the plane of the bed-plate 21. The lowering operation of the carrier causes the cup 91, containing the coating solution and the rotating coating wheel 92 supported on the standard 93, to become disengaged from the filamentary material 23 which normally lies in the groove of the coating wheel 92. The lowering of the carrier prevents contact between the filamentary material and the lip of the cup 91 when the carrier is drawn towards its retracted position and therefore prevents injury to the fragile filamentary material during the operation of the carrier. When the rollers have reached the limit of the inclined surfaces 71 of the guideways 65 and 66, the continued rotation of the hand wheel causes the rollers to travel in the horizontal portion of the guideways until the rigid arms 80 and 81 have reached the limit of their arcuate travel. During this movement of the rollers the rear portion of the carrier 60 enters a space below the rear of the bed-plate 21.

Since the coating wheel 92 is continuously rotated when the coating unit is in operative position and functioning to apply a coating of thermionically active material to the filamentary material 23 and the fact that the coating wheel is driven from the main shaft 35, it is necessary to provide adjustable driving means between the coating unit supported on the movable carrier and the main drive shaft which does not change its position. In accordance with this invention, the coating wheel 92 is continuously driven by the main drive shaft 35 through the swinging telescopic shaft 41. As shown in Figs. 3 and 10 the coating unit 30 comprises a removable cup 91 supported on a standard 93, rigidly attached to the carrier 60 and also includes an upright motor 94 connected to a stirring rod 95 extending into the cup 91. The stirring rod 95 agitates the

coating material in the solution and maintains a uniform solution which is taken up by the rotating wheel 92 immersed in the solution. The rotating wheel 92 is driven by a stub shaft 96 extending horizontally through the side of the standard 93. This shaft carries a bevel gear which engages a similar gear carried by shaft 97 supported by a swinging arm 98 which is supported on the rotating stub shaft 96. The shaft 97 beyond the arm 98 is of rectangular cross-section and is rigidly connected to a hollow square shaft 99 in sliding engagement with a solid rectangular length of shaft 100. The shaft 100 extends through a swinging yoke arm 101 which is supported on opposite sides of gear 102 attached to drive shaft 35, the shaft 100 carrying a gear 103 which engages the gear 102 on the main drive shaft. This arrangement permits continuous engagement between the main drive shaft and the coating unit either in operative or in idle position since the telescopic shaft 99 permits elongation or contraction of the driving shaft for the coating unit during the transfer operation of the carrier.

It is evident from the different inclinations of the drive shaft 41 of the coating unit in Figs. 3 and 4 that the provision of the swinging arm on the coating unit and the swinging yoke on the main drive shaft insures continuous operation of the coating wheel 92 regardless of the position of the carrier with respect to the bed-plate 21. The rotation of the coating wheel 92 and the stirring rod 95 when the coating unit is in the retracted position maintains the coating solution in proper condition and prevents caking of coating material in the groove of the rotating wheel 92. An elongated slot 104 in the bed-plate 21 adjacent the coating unit 30 permits the telescopic shaft 41 of the coating unit to swing in an arc when the carrier is transferred from either its operating position or its retracted position. The coating unit 30 and baking oven 29, as shown on the carrier 60 in Figs. 3 and 4, illustrate the relationship of the elements or units looking in a right-hand direction from the end of Fig. 1. Similar transfer mechanism is associated with the carrier 60 on which the coating unit 26 and baking oven 25 are mounted which is shown to the left of the conveyor frame 22 in Fig. 1. This carrier is operated by the hand wheel 59 in the same manner as described in Figs. 3 and 4.

Since the baking oven also surrounds the filamentary material 23 in its travel through a complete cycle of operation and this unit is mounted on the carrier 60, it is necessary to open the oven when it is desired to convey the unit on the carrier to an inoperative position and at the same time perform the opening operation of the oven without injury to the filamentary material which extends therethrough. According to this invention, this operation is performed automatically during the transfer operation of the carrier from its operative to inactive position and on the reverse operation of the carrier the oven automatically surrounds the filament without injury. The operation of this feature of the invention will be more clearly understood from the following description in connection with Figs. 7 to 9, inclusive, which show various positions of the baking oven during the transfer operation of the carrier 60.

The baking ovens 25 and 29 are cylindrical structures arranged horizontally on the carrier 60 and are formed of two semi-cylindrical sections 105 and 106, the section 105 being the upper part and movable while the section 106 is the lower

part which is rigidly attached to the carrier 60 by an upright support 107. The two sections of the baking oven are hinged together at the rear of the oven along a horizontal diameter and each section of the oven is provided with a central convex opening 108 to form a cylindrical channel through which the filamentary material 23 may be drawn. A stationary cam 109 is mounted on the bed-plate 21 adjacent the end of the oven remote from the coating unit. An angular shift arm or lever having a spanning portion 110 is affixed to the side wall of the upper section 105 of the baking oven and the rear end is pivoted on the hinge pintle 111. The lever is provided with a downwardly extending portion 112 carrying a roller 113 which engages the surface of the cam 109 on the bed-plate 21.

When the carrier 60 is in a normal or operative position as shown in Fig. 7, the filamentary material 23 occupies the center of the channel formed by the convex portions 108 of the baking oven and the roller 113 lies on the horizontal surface of the cam 109. When it is desired to transfer the carrier 60 to a retracted position the hand wheel is rotated, as previously described, and the initial movement of the carrier causes the rollers 63 and 64 to travel downwardly in the guideways 65 and 66 thereby lowering the carrier below the surface of the bed-plate 21 as shown in Fig. 8. The lowering of the carrier 60 causes the lower section of the baking oven which is rigidly fastened to the carrier to drop to a lower level but since the lever arm is in contact with the flat surface of the cam 109, the arm forces the upper section 105 of the oven to open and in this position the filamentary material is shown at 23. As the carrier moves rearwardly through the operation of the hand wheel, the oven recedes from the filamentary material until the edge of the section 105 is clear of the filament. When the roller 113 on the lever 112 starts to glide down the inclined surface of the cam 109 the oven closes as shown in Fig. 9. In reversing the operation above described to return the carrier to the operating position it will be evident that as the roller 113 ascends the sloping surface of the cam 109, the oven will be opened and the further movement forward of the oven and carrier will cause the sections of the oven to move towards the filamentary material and when the carrier 60 is raised to the level of the bed-plate 21 the oven will close around the filament 23 without danger of breaking the filament or causing any injury to it.

In the description of the complete machine, as shown in Fig. 1, reference was made to the supply of the filamentary material 23 from a supply reel such as the drum 28 and taken up on a take-up reel such as drum 32. Due to the fragile nature of the filamentary material it is extremely important that the feeding operation be performed uniformly so that no undue strain is placed upon the filamentary material. Consequently, the feeding of the filamentary material from the supply reel and the winding of the material on the take-up reel must be performed at a uniform rate of speed and in accordance with this invention both of these reels are driven from a common driving source such as the main drive shaft 35. Since both of the drums 28 and 32 are driven through similar coupling mechanism it is evident that a description of one driving coupling mechanism will suffice for both drums. Therefore, the illustration of the driving mechanism for the drum 32 as shown in Figs. 11 to 15, inclusive, will also apply to the mechanism for

the drum 28 on the opposite end of the machine as shown in Fig. 1.

The main drive shaft 35, as shown in Fig. 12, carries a bevel gear 114 at its extreme right end which engages a similar gear 115 on transverse shaft 46 supported in journal housing 116 extending below the bed-plate 21. A bevel gear 117 at the opposite end of the shaft 46 is in mesh with the gear 118 on the end of shaft 47 which is supported by journal housing 119 in an angular position extending outwardly from the base of the machine. At the opposite end of the shaft 47 is a gear 120, Fig. 11, which is in engagement with a similar gear 121 attached to shaft 48 which also supports a cylindrical gear 122. The shaft 48 is mounted in bearings of the stationary journals 123 and 124. Directly above the shaft 48 is a long longitudinal shaft 49 extending from the journal 123 and connected to a feed screw 125 which extends through a threaded bearing 126 on the journal 124. The feed screw 125 carries a large spur gear 127 which is rigidly attached to the feed screw 125 adjacent the journal 123 and engages the cylindrical gear 122 on the shaft 48 to impart rotation to the shaft 49 and transverse progressive movement of the reel or drum 32 due to the feed screw 125 extending through the bearing 126. When the spur gear 127 has reached a position as shown in dotted line in Fig. 11, rotation of the drum must be stopped, since the limit of travel of the shaft has been reached.

During one cycle of coating operation, for instance as shown in Fig. 1, with the drum 28 as the supply reel and the drum 32 as the take-up reel, it is evident that both of these drums are rotated in the same direction and are advanced in opposite transverse directions simultaneously through the feed screws 125. Since this invention contemplates a coating machine which requires a minimum of manual attention, it is obvious that upon completion of the coating of the filament 23, that is, when all the material is unwound from the supply reel 28 and wound upon the take-up reel 32, the machine must be stopped and reversed to start another coating cycle in the direction from the drum 32 to the drum 28. In accordance with this invention the power source is automatically disconnected upon the termination of each coating cycle by providing switching mechanism adjacent the limiting positions of the traveling spur gear 127 on one of the shafts 49 as shown in Fig. 15. A plunger type key or switch 128 is mounted within the gear housing enclosing the gear 127 and feed screw 125 and is positioned adjacent the spur gear 127 as shown in Fig. 15. This key is provided with a plunger 129 connected to an arm 130 carrying a roller 131 which is engaged by the spur gear 127 when it reaches its forward limiting position. The forward movement of the gear 127 actuates the arm 130 through the pivot 132 to force the plunger 129 into engagement with the contacts of the key 128. This actuating operation is shown to the right of Fig. 15 which illustrates the gear 127 forcing the plunger 129 of a similar key mounted adjacent the rear limiting position of the gear 127. Actuation of the contacts of the key 128 in either limiting position of the gear 127 discontinues the supply of power to the drive shaft and sounds an alarm to inform the operator that the coating cycle has been completed. The operator then transfers one of the carriers supporting a coating unit and baking oven from a retracted to an active position

in line with the filamentary material and also transfers the other carrier from its active position to a retracted position and finally reverses the rotation of the drive shaft through the operation of the shift handle 52 and starts the machine operating in the opposite direction.

After an indication is given to the operator regarding the condition of the machine, for instance when a complete cycle of coating the filamentary strand is terminated by the operation of either switch 128 or 133, it is necessary to return the alarm circuit to normal to discontinue the ringing of the bell 170 as shown in Fig. 19, and reestablish the motor circuit. These operations are accomplished by positioning two keys 171 and 172, which are similar to keys 128 and 133, on the opposite sides of the shift bar 51 below the bed-plate 21. These keys are arranged to be actuated by the rear end 173 of the shift bar 51.

While the filamentary material 23 ordinarily is under no undue strain due to the rotation of the take-up reel or caused to be strained by its passage through the various elements of the machine, certain mechanical defects in the structure of the filamentary material are apt to cause fracture or breakage during the coating operation. When a filament breaks it is necessary to inform the attendant or operator of this fact in order that the fracture of the filament may be repaired before continuing the coating operation.

In accordance with this invention, the filament supports a gravity member adjacent each end of the machine and upon release of the gravity member due to the filament being broken, the downward fall of the gravity member operates a trip lever to actuate a switching mechanism for disconnecting the source of power from the drive shaft and rings an alarm to inform the operator. A guide assembly such as 27 and 31 on opposite ends of the table is positioned between the drum and the coating unit and comprises two stationary standards 134 and 135 mounted on the bed-plate 21 and supporting adjustable guide rollers 136 and 137 respectively. The filamentary strand 23 extends across the guide rollers and suspends an intermediate guide roller 138 supported on a split frame 139 attached to a plunger rod 140 having a dash-pot 141 at its end immersed in a receptacle 142 containing oil. When the filamentary strand 23 is broken or fractured the suspended guide roller 138 is released and dropped by gravity to the base 143. In dropping to the base the suspended guide element strikes a trip lever 144 which extends into the path of movement of the suspended element and is supported on a pivot mounting 145. The trip lever 144 carries a downward arm 146 which travels in an outward arc when the trip lever 144 is depressed. The outward movement of the arm 146 actuates a pivoted handle 147 of key 148 which operates to discontinue the source of power for the motor attached to the drive shaft and rings an alarm to inform the operator of the condition of the filamentary strand so that the strand may be repaired and the coating operation continued.

Although no strain is ordinarily placed upon the strand of filamentary material 23 during the various processes through the elements of the machine, limited elongation occurs in the strand due to the difference in expansion and contraction when the filament is flashed in the conveyer frame 22. This limited elongation is generally of no consequence but tends to increase the wastage of the completed filament due to successive portions of the filament being gripped by the trav-

eling grippers on the conveyer frame during the flashing operation. Therefore, compensation for the elongation of the filamentary wire or ribbon must be made to prevent the grippers on the conveyer frame from engaging with different points of the wire during successive coatings of the wire. This is accomplished in accordance with this invention by providing adjustable drums which may be varied in their circumference to compensate for expansion or elongation of the filament after the first coating is applied thereto. Due to the provision of adjustable drums the filament 23 traveling through the various successive coating cycles is always gripped within close limits at the same place as in the initial coating cycle. Therefore, the amount of wastage of filamentary material is reduced to a minimum. The adjustable type drum, for instance the drum 32, as shown in Figs. 11 and 12 consists of two semi-cylindrical sections 149 and 150 joined together internally on one edge by hinge members 151 through which extend a pintle 152. On the opposite edges of the sections of the drum within the cylindrical structure are elongated plates 153 and 154 having opposed angular extensions 155 and 156 respectively. The angular projections are connected by an adjusting screw 157 whereby the circumference of the drum may be changed to compensate for the elongation of the filamentary wire 23. One end of the drum is closed by two similar semi-circular plates 158 which are connected to a hub 159 having a central collar provided with a bayonet slot 160 which engages a bayonet pin 161 on the shaft 49. Within the opposite end of the drum are two similar plates 162 and 163 shown in Fig. 12 fastened to the sections of the drum and to a central collar 164 which fits over the ends of the shaft 49 and is secured thereto by a nut 165. The front and rear semi-cylindrical plates attached to the sections of the drum are spaced apart at the center as shown in Fig. 12 to permit adjustment of the drum periphery and openings are cut in the plate to permit access to the adjustable link 157 within the drum. The drum is also readily removable from the shaft 49 merely by loosening the nut 165 so that the drum may be drawn from the shaft. The removable drum permits the conveying of the filamentary material after the coating operations are completed without the necessity of unwinding the wire or ribbon from the drum while on the machine.

Automatic discontinuance of the power source for driving the machine and the automatic signaling of the operator will be more clearly understood from the circuit diagram shown in Fig. 19 which illustrates the connections of the various elements to the power source and alarm. The electrical alarm and motor circuit as shown in Fig. 19 is in normal inoperative position with the key 55 open in the motor circuit and the bell 170 inoperative through the upper open contact of each key 148 and the lower open contact of keys 172 and 128.

In order to start the machine, current is supplied to the primary left-hand winding of the circuit breaker and an induced current flows through the intermediate and right-hand winding over a complete circuit through the closed contacts of both keys 148 and the closed contacts of keys 128 and 133. The armature of the circuit breaker is drawn up to engage the contacts associated with the circuit breaker. The respective switches 54, 55 and 56 are then operated, to energize the small overhead motors of

the coating elements 26 and 30, to complete the circuit for the motor 33, and to supply current to the heating elements in the baking ovens 25 and 29, respectively. When the drums 28 and 32 are in advanced position, as shown in Fig. 11, the direction of movement of the filamentary strand 23 is from the supply reel 28 to the take-up reel 32 and these reels are driven in a clockwise direction by moving the shift handle 52 which is shown in neutral position in Fig. 1 to the right so that the left-hand bevel gear of the shift unit 50 engages the bevel gear on the upright drive shaft 36. When it is desired to reverse the operation of the machine the shift handle 52 is moved to a left-hand position of the slot 53 and this operation disengages the left-hand bevel gear of the shift unit 50 and engages the right-hand bevel gear with the upright drive shaft 36. Assuming, for example, it is desired to coat a length of filamentary wire or ribbon 23 which is wound on the supply reel 28, the preliminary operation before starting the machine consists in attaching the filament to a follower wire which is threaded through the guide unit 27, over the coating wheel in the coating unit 26 through the baking oven 25, extended along the length of the conveyer frame 22, applied to the guide unit 31 and then fastened to the take-up reel 32. In the direction of travel of the filament 23 from the supply reel 28 to the take-up reel 32, the carrier 60 supporting the baking oven 29 and coating unit 30 is transferred to a retracted position by the operation of the hand wheel 58.

In order to start the rotation of the elements connected to the main drive shaft 35, the shift bar 51 is moved to the right of the slot 53 and the rotation of the various elements commences as previously described. Upon the movement of the shift bar 51 to the right in the slot 53, the rear end 173 thereof is moved to the left and this movement causes the operation of switch 172 which prepares the circuit for the alarm 170 through the closing of the lower contact 174 which is connected to the alarm circuit through conductor 175. However, this circuit is incomplete due to the open condition of the contact 176 of key 133. Now, when the complete length of filament 23 is coated and wound on the take-up drum 32 the large spur gear 127 on the feed screw 125, as shown in Fig. 15, will strike the arm 130 of key 133, thereupon depressing the key and closing the upper contact 176 and opening the lower contact 177. When key 133 is operated it completes the alarm circuit and disconnects the motor circuit through the closing of the contact 176 and the opening of contact 177. The alarm circuit may be traced from one side of the bell 170, conductor 175, closed contact 174 and its associated spring of key 172, conductor 178, spring and closed contact 176 of key 133, conductors 179 and 180 to the midpoint of the circuit breaker 181, intermediate winding of circuit breaker, conductor 182, to the other side of the bell 170. At the same time the series circuit of the double winding of the circuit breaker 181 is disconnected through the open contact 177 and spring of relay 133. Due to the series winding being disconnected the armature 183 is released, thereby opening the contacts 184 and 185 and current for the motor 33 is discontinued. When the alarm rings, the operator, upon arriving at the machine, throws the shift bar 51 into a neutral position and this operation returns switch key 172 to its normal position as shown in

Fig. 19. The circuit for the alarm is disconnected through the lower contact and spring of switch key 172 and the circuit breaker 181 is energized over a circuit which includes closed contact 186 and spring of key 172, closed contact 187 and spring of key 171, conductor 188, closed contact 191 of switch key 148, conductors 182, intermediate and right-hand windings of circuit breaker 181, conductor 190, spring and closed contact 191 of switch key 148, conductors 192 and 193. During this time the key 133 remains actuated due to the position of the gear 127 in engagement with the arm 130 of this key.

The operator then turns hand wheel 58 to advance the baking oven 29 and coating unit 30 supported on the carrier 60 to its advanced or operative position surrounding the filament 23 and also operates hand wheel 59 to transfer the carrier 60 supporting the baking oven 25 and coating unit 26 to a retracted position. After these operations are completed, the machine is in condition to apply the second coating of thermionically active material to the filament 23. The operator then moves the shift bar 51 to the left of the slot 53 to bring the right-hand bevel gear of the shift unit 50 into engagement with the bevel gear on the upright shaft 36. When the shift bar 51 is moved to its left-hand position the rear portion 173 of the bar operates key 171 to close its upper contact and open the lower contact. This prepares the alarm circuit for the reverse operation of the machine. Upon the initial forward movement of the drum 32 which now serves as a supply reel, key 133 is released and returns to its normal position as shown in Fig. 19. The filament is then passed through the coating unit 30, baking oven 29, conveyer frame 22 and wound on take-up reel 28. When the complete length of filament 23 has been unwound from reel 32 and transferred to reel 28, the forward movement of the spur gear 127 on the feed screw 125 actuates the arm 130 of key 128. This operation causes the normally closed contact 194 to be disconnected from its associated spring and also causes the normally open contact 195 to engage its associated spring. Thereupon the alarm circuit is completed to ring the bell 170 over a circuit from lower contact 195 of key 128, conductors 196 and 197, bell 170, conductor 182, intermediate winding of circuit breaker 181, conductors 198 and 199, upper contact 200 and its associated spring of key 171 which is now in closed condition, and conductor 178 to the spring of key 128. At the same time the motor source is disconnected over a circuit from open contact 194 of key 128, closed contact 177 and its associated spring of key 133, conductors 201 and 188, closed contact 189 and spring of key 148, conductor 183, intermediate and right-hand winding of circuit breaker 181, conductor 190, spring and closed contact 191 of key 148, conductor 192 to the upper spring of key 148. The circuit breaker releases the armature 183 which opens contacts 184 and 185 and the motor 33 stops.

When the operator is apprised of the completion of the cycle of coating operation due to the ringing of the alarm he immediately throws the shift bar 51 to a neutral position and discontinues the ringing of the alarm through the opening of contact 200 associated with key 171. At the same time an energizing circuit is completed for the circuit breaker 181 through the closing of contact 187 and spring of switch key 171, and conductor 188, closed contact 189 and spring of key 148, conductor 182, intermediate and right-

hand winding of circuit breaker 181, conductor 190, spring and closed contact 191 of key 148, conductors 192 and 193, spring and contact 186 of key 172 to contact 187. The armature 183 is then drawn up through the solenoid winding of circuit breaker 181 to close contacts 184 and 185 to start the motor 33. Successive coatings may be applied to the filamentary wire 23 in opposite direction of travel and it will be apparent from the foregoing description that at the termination of each cycle of operation the alarm will be sounded and the motor circuit disconnected to inform the operator to reverse the travel of the wire 23 and manipulate the hand wheels 58 and 59 to transfer the coating element and baking oven on each movable carrier to desired positions depending upon the direction of travel of the filamentary wire 23.

Although the filament 23 is not subjected to any strain or tension during its travel from one drum to the other, rupture of the filament may occur either due to mechanical handling or inherent weakness in the structure of the filamentary material. If such rupture occurs during any coating cycle, it is evident that the coating operation should be discontinued and the operator notified regarding the condition of the material. In accordance with this invention, fracture or breakage of the filamentary material 23 is immediately called to the operator's attention so that the necessary repairs may be made and the process of coating continued. As shown in Fig. 1 and described in detail in Figs. 17 and 18, the filament 23 supports a gravity guide 138 between the stationary guide units at opposite ends of the machine. The purpose of providing a gravity suspension member at each end of the machine is to control a section of the filament which may be held between the supply drum 28 and the grippers on the conveyer frame 22 and also to control the section of filament between the conveyer frame 22 and the take-up drum 32. The operation of the machine is discontinued and an alarm sounded when either of the suspension elements 128 engages a trip lever 144 due to the breaking of the filament 23. The trip lever actuates key 148 to ring the alarm and stop the motor.

When key 148 in the left-hand position of the machine is actuated it closes the alarm circuit through contact 202 and this circuit may be traced from one side of the bell 170, contact 202 and its associated spring, conductor 198 to the midpoint of the circuit breaker winding 181, intermediate winding of the circuit breaker, conductor 182 to the other side of the bell 170. At the same time the motor circuit is opened or disconnected by the opening of contact 189 associated with the spring of key 148. This circuit may be traced from contact 189, conductors 188 and 201, closed contact 177 and spring of key 133, closed contact 194 and spring of key 128, conductor 192, closed contact 191 and spring of right-hand key 148, conductor 190, right-hand and intermediate winding of circuit breaker 181, conductor 182 to the spring of key 148 associated with contact 189. The opening of the circuit breaker winding circuit releases the armature 183 and disconnects current from the motor 33 over the contacts 184 and 185 of the circuit breaker. The operator immediately shifts bar 51 to a neutral position and this operation discontinues the ringing of the alarm and reestablishes the circuit for the circuit breaker 181 through the closing of contact 189 to draw up the armature 183. The operator then makes the necessary repair to the

filament 23 and continues the coating operation by shifting the bar 51. When the fracture occurs in the section of filament 23 between the conveyor frame 22 and the reel 32, the right-hand key 148 is actuated and in operating closes contact 203 to ring the alarm 170 over a circuit from one side of the bell 170, conductor 197, closed contact 203 and its associated spring of key 148, conductor 180, intermediate winding of the circuit breaker 181, conductor 182, to the opposite side of bell 170. The motor circuit is disconnected over the open contact 191 of key 148 and its associated spring, conductor 190, right-hand and intermediate windings of circuit breaker 181, conductor 182, spring and closed contact 189 of left-hand key 148, conductors 188 and 201, spring and closed contact 177 of key 133, closed contact 194 and spring of key 128, and conductor 192 to contact 191 of key 148. The operator is again apprised of the condition of the filament and he performs the same operation as previously described in connection with the operation of key 148 in the left-hand position.

While the machine of this invention is primarily adapted for the coating of the filamentary material with thermionically active material, which is flashed to a high temperature on the conveyor frame, to accomplish conversion of the thermionically active material deposited on the filamentary strand, it is of course understood that the machine of this invention may be adapted for coating wire with various materials in which the wire is successively passed through a number of units such as a coating unit and baking unit in opposite directions of travel to apply superimposed layers of material on the strand or wire. Therefore, the invention is to be limited only within the scope of the appended claims.

What is claimed is:

1. In combination, a machine for coating electrical conductors in opposite directions of travel comprising a base, a rotatable drum at each end of said base, a coating unit and baking oven successively positioned adjacent each drum, a carrier adjacent each drum supporting a single coating unit and baking oven, a flashing frame intermediate the carriers, means for transferring each carrier to rear and forward positions with respect to said base, and common means for driving the drums, coating units and flashing frame simultaneously.

2. In combination, a machine for coating electrical conductors in opposite directions of travel comprising a base, a rotatable drum at each end of said base, a coating unit and baking oven successively positioned adjacent each drum, a carrier adjacent each drum supporting a single coating unit and baking oven, means for transferring said carrier to rear and forward positions with respect to said base, means automatically opening said oven during the transferring period, a flashing frame intermediate the carriers, and a common driving means for the drums, coating units and frame.

3. In combination, a machine for coating wire material in opposite directions of travel comprising a base, a rotatable drum at each end of said base, a coating unit and baking oven successively positioned adjacent each drum, a carrier adjacent each drum supporting a single coating unit and baking oven, means for successively transferring said carrier to rear and forward positions with respect to said base depending on the direction of travel of the wire material, a flashing frame intermediate the carriers, and driving

means for operating the drums, coating units and frame, the driving means for said coating unit being continuously applied during the transferring period.

4. In combination, a machine for coating conducting material in wire form in opposite directions of travel comprising an endless conveyor, a base supporting said conveyor, a rotatable drum at each end of said base, an oven and a coating unit located between each drum and said conveyor, a movable member supporting each oven and coating unit group, means for driving said conveyor, the drums and coating units, and means to successively bring each movable member into action.

5. In combination, a machine for coating filamentary material in opposite directions of travel comprising an endless conveyor, a base supporting said conveyor, a rotatable drum at each end of said base, a coating unit located between each drum and said conveyor, a separable oven adjacent each coating unit, a slidable carrier supporting each coating unit and oven, means for driving said conveyor, the drums and coating units, and means automatically opening and closing said oven upon displacement of said slidable carrier.

6. In combination, a machine for coating filamentary material in opposite directions of travel comprising a base, a rotatable drum at each end of said base, a coating unit and baking oven successively positioned adjacent each drum, a carrier adjacent each drum supporting a single coating unit and baking oven, said drums adapted to convey a traveling filamentary material through a coating unit and baking oven in each direction of travel, a flashing frame intermediate the carriers, means for driving the drums, coating units and flashing frame, and means acting in conjunction with each coating unit and baking oven to cause said unit and oven to be removed without injury to said traveling material.

7. In combination, a machine for coating filamentary material in opposite directions of travel comprising a base, a rotatable drum at each end of said base, a coating unit and baking oven successively positioned adjacent each drum, a carrier adjacent each drum supporting a single coating unit and baking oven, a flashing frame intermediate the carriers, means for driving the drums, coating units and flashing frame, means for initially dropping said carrier below the plane of said base, and means for propelling said carrier partially under said base.

8. In combination, a machine for coating filamentary material in opposite directions of travel comprising a base, a rotatable drum at each end of said base, a coating unit and baking oven successively positioned adjacent each drum, a carrier adjacent each drum supporting a single coating unit and baking oven, a flashing frame intermediate the carriers, driving means for the drums, coating units and flashing frame, guideways on said base for said carrier, a propeller arm on said carrier, and operative means on said base acting on said arm to transfer said carrier in said guideways with respect to said base.

9. In combination, a base, a movable carrier, guideways on said base for said carrier, a propeller arm on said carrier, a two-part cylindrical baking oven and a coating unit supported on said carrier, a rotatable drum on each end of said base adapted to convey a length of filament through said coating unit and oven successively, a stationary cam on said base adjacent said oven, a rigid

lever on one part of said oven engaging said cam, means for initially opening said oven and removing said unit from said filament by lowering said carrier, and means for displacing said oven and carrier to the rear of said base.

10. In combination, a machine for coating filamentary material, comprising a base, a movable carrier on said base, a coating unit and baking oven supported on said carrier, a main drive within said base, a telescopic shaft in engagement with said coating unit and main drive, and swinging members on said unit and main drive respectively supporting said shaft in relation to said coating unit and main drive.

11. In combination, a base, a movable carrier on said base, a coating unit supported on said carrier, a main drive for said coating unit in said base, a telescopic shaft in engagement with said coating unit and main drive, swinging members on said coating unit and main drive supporting said shaft, and means for moving said carrier whereby said shaft changes in length while imparting rotary movement from said drive to said coating unit.

12. The combination in a filamentary coating machine, a pair of spaced drums adapted to wind and suspend a continuous length of filamentary material therebetween, means for rotating said drums in a progressive axial direction, switching mechanism adjacent one of said drums, and means carried by said rotating means for actuating said switching mechanism when said drums have reached either of their progressive limits.

13. The combination in a strand coating machine, a base, a rotary drum on each end of said base, means for driving said drums simultaneously, means for progressively moving said drums axially in either direction, a strand of material adapted to be wound on said drums and transferred from one to the other, and means actuated by said progressively moving means for indicating the termination of the transfer of said strand material from one drum to the other and simultaneously stopping said driving means.

14. The combination in a coating machine, a base, rotatable drums on opposite ends of said base adapted to support and transfer an electrical conductor through a coating mechanism therebetween, a main drive for rotating said drums, shifting means for controlling the rotation of said main drive, an alarm circuit, a motor circuit, switching means associated with said shifting means for preparing said alarm circuit, and switching means associated with one of said drums for completing said alarm circuit and controlling said motor circuit.

15. In combination, a base, a drum at each end of said base on which filamentary material is adapted to be wound and transferred from one drum to the other drum, a gravity member engaging said material between said drums, an alarm circuit, a motor circuit, and switching means actuated by the release of said gravity member when the material breaks to control said alarm and motor circuit.

16. In combination, a machine for coating filamentary material comprising an endless conveyer, a plurality of spaced grippers on said conveyer adapted to contact at certain points of the filamentary material, a base supporting said conveyer, and a rotatable drum at each end of said

base, said drum being adjustable in diameter to compensate for expansion of said material to insure recurrent contact at the certain points between said grippers and said material.

17. In combination, a machine for coating filamentary material comprising an endless conveyer, a plurality of spaced grippers on said conveyer, a base supporting said conveyer, cylindrical rotatable drums at opposite ends of said base adapted to support and transfer said material therebetween, said material in transferring from one drum to the other being engaged by said grippers, each of said drums being formed of two half sections hinged together on one side, and adjustable means coupling the other side of said sections to vary the circumference of said drums.

18. A coating machine comprising a base, rotatable drums at opposite ends of said base and adapted to wind and suspend a continuous length of filamentary material therebetween in opposite directions of travel, a continuous conveyer frame intermediate said drums supported on said base, a coating unit and baking oven between each of said drums and said conveyer frame, a movable carrier supporting said baking oven and coating unit, means for successively advancing one of said coating units and baking ovens on a carrier into operative position to apply a coating of material to said filamentary material and baking said coating thereon during each successive coating cycle, means on said conveyer for flashing said coated material, means for removing the succeeding baking oven and coating unit on a carrier between said conveyer and said other drum from the immediate vicinity of said material, means for driving said drums, coating units and conveyer frame, and a stop switch actuated by one of said drums reaching its limit of travel to disconnect said driving means.

19. A coating machine comprising a base, rotatable drums at opposite ends of said base and adapted to wind and suspend a continuous length of filamentary material therebetween in opposite directions of travel, a continuous conveyer frame intermediate said drums supported on said base, a coating unit and baking oven between each of said drums and said conveyer frame, a movable carrier supporting said baking oven and coating unit, means for advancing one of said coating units and baking ovens on a carrier into position to apply a coating of material to said filamentary material and baking said coating thereon, means on said conveyer frame for flashing said coated material, means for removing the succeeding baking oven and coating unit on a carrier between said conveyer and said other drum from the immediate vicinity of said material, means for driving said drums, coating units and conveyer frame, suspension means between each drum and coating unit engaging said material, a stop switch actuated by one of said drums reaching its limit of travel, a break switch adjacent said suspension means adapted to be actuated when said material breaks, and indicating means connected to said stop switch and break switch.

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