

June 26, 1962

G. D. MINNICK ET AL
APPARATUS FOR SPRAY COATING SMALL ARTICLES
WITH IMPROVED MASKING MEANS

3,040,701

Filed June 25, 1959

5 Sheets-Sheet 1

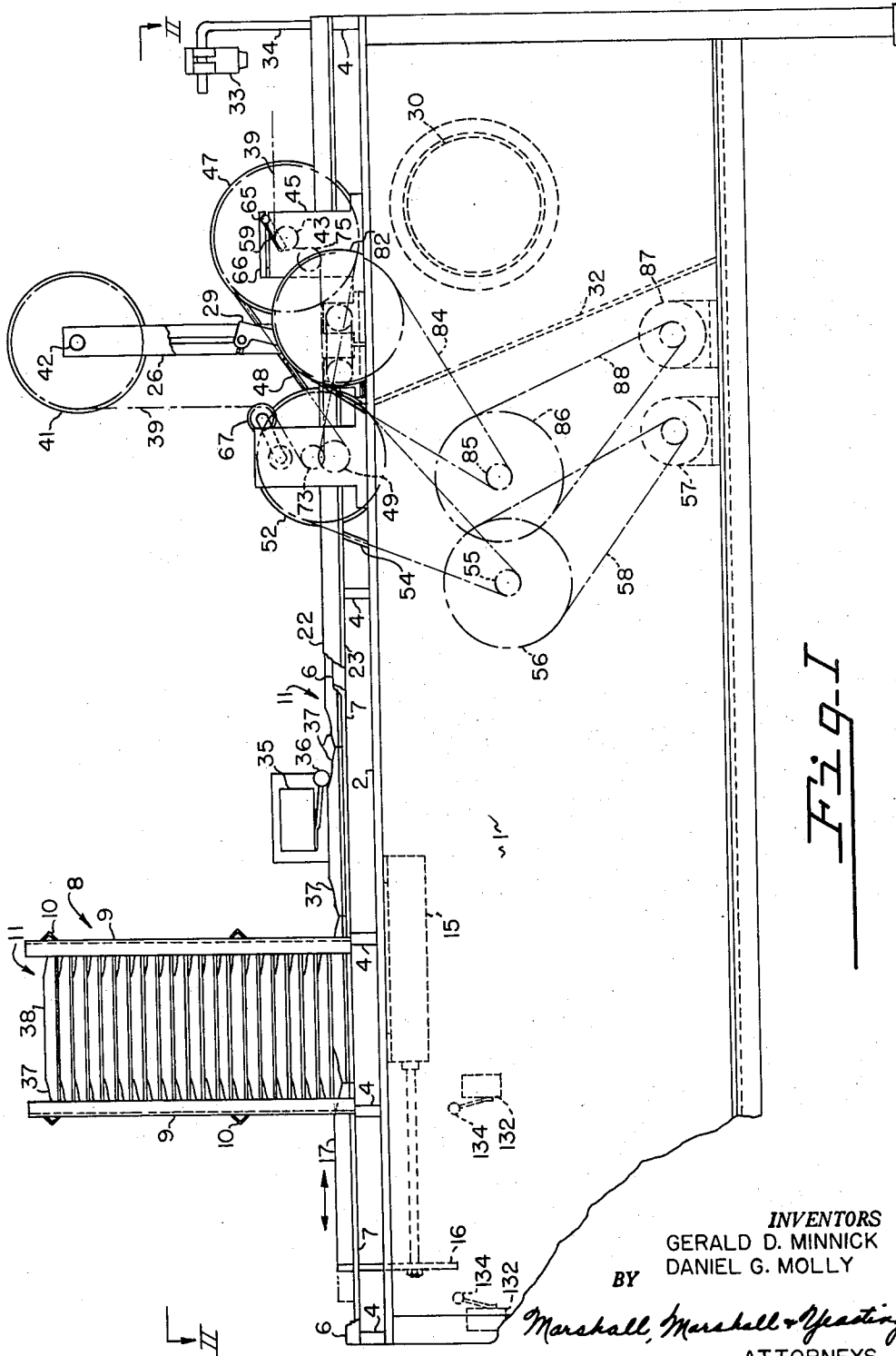


Fig. 1

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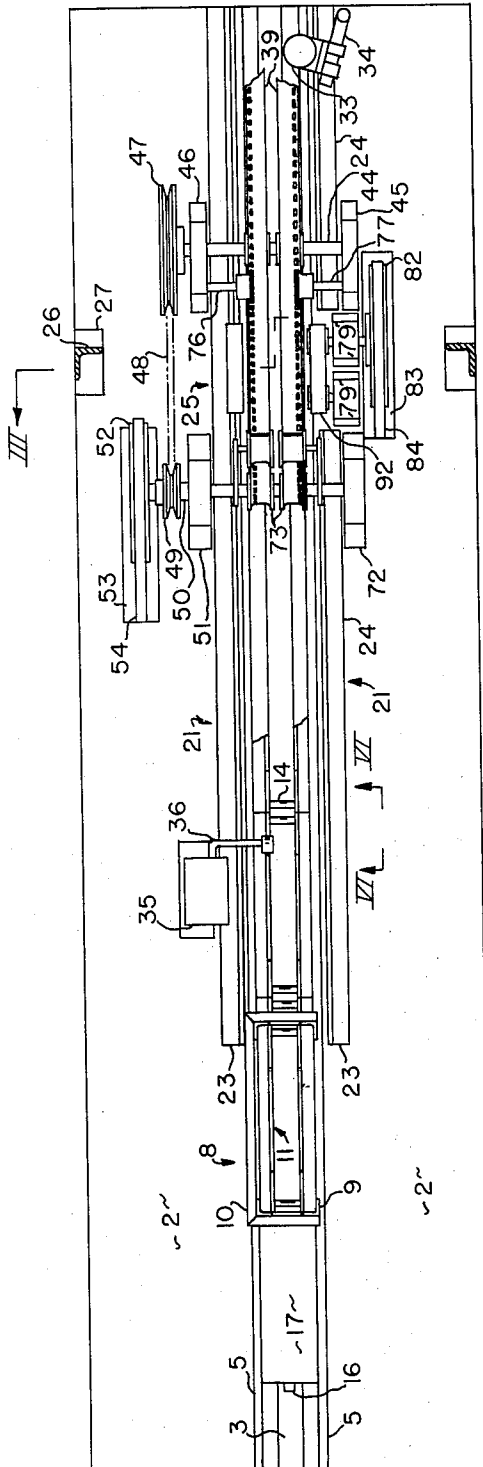


Fig. II

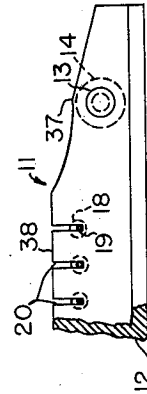


Fig. VI

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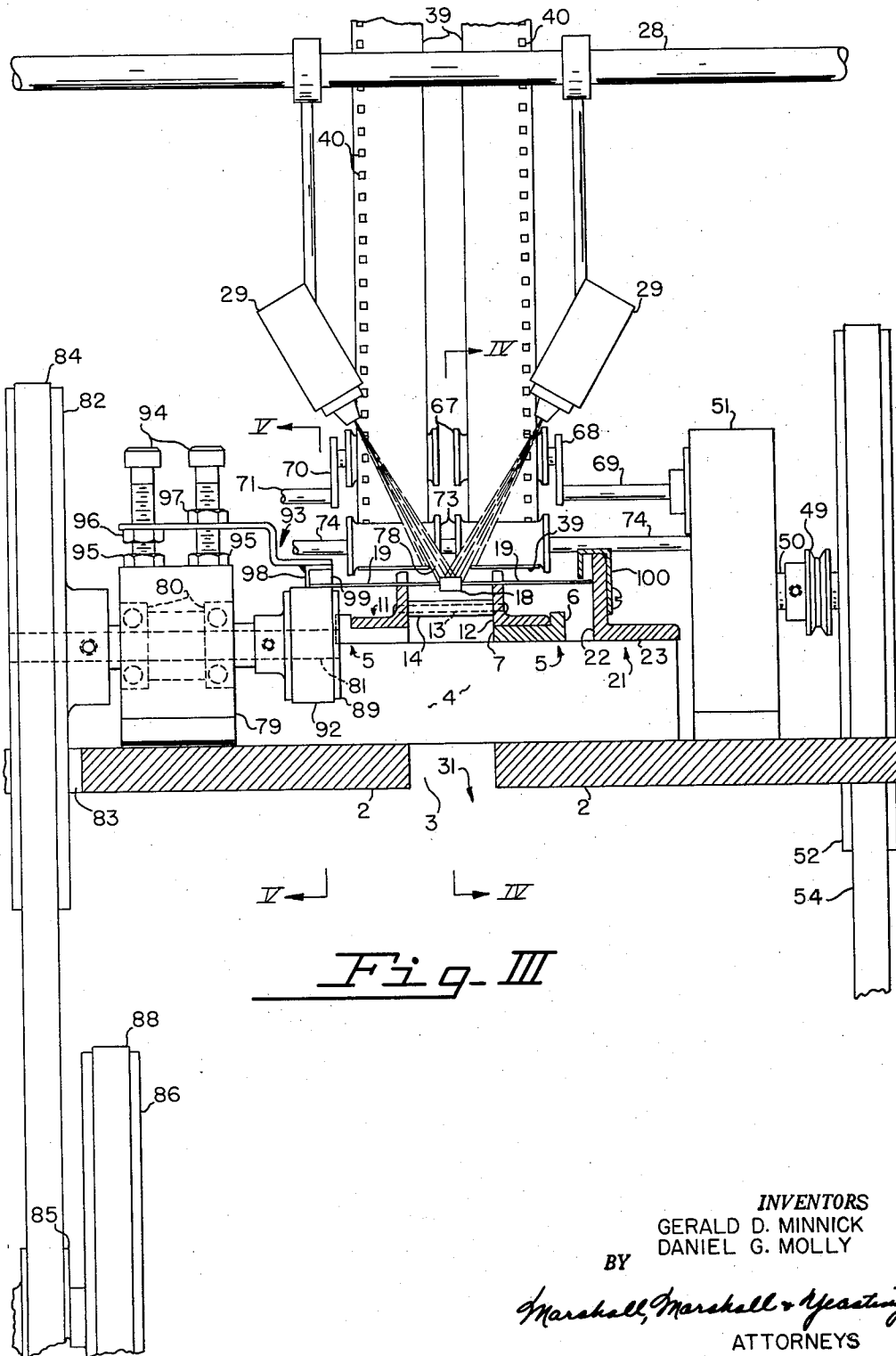
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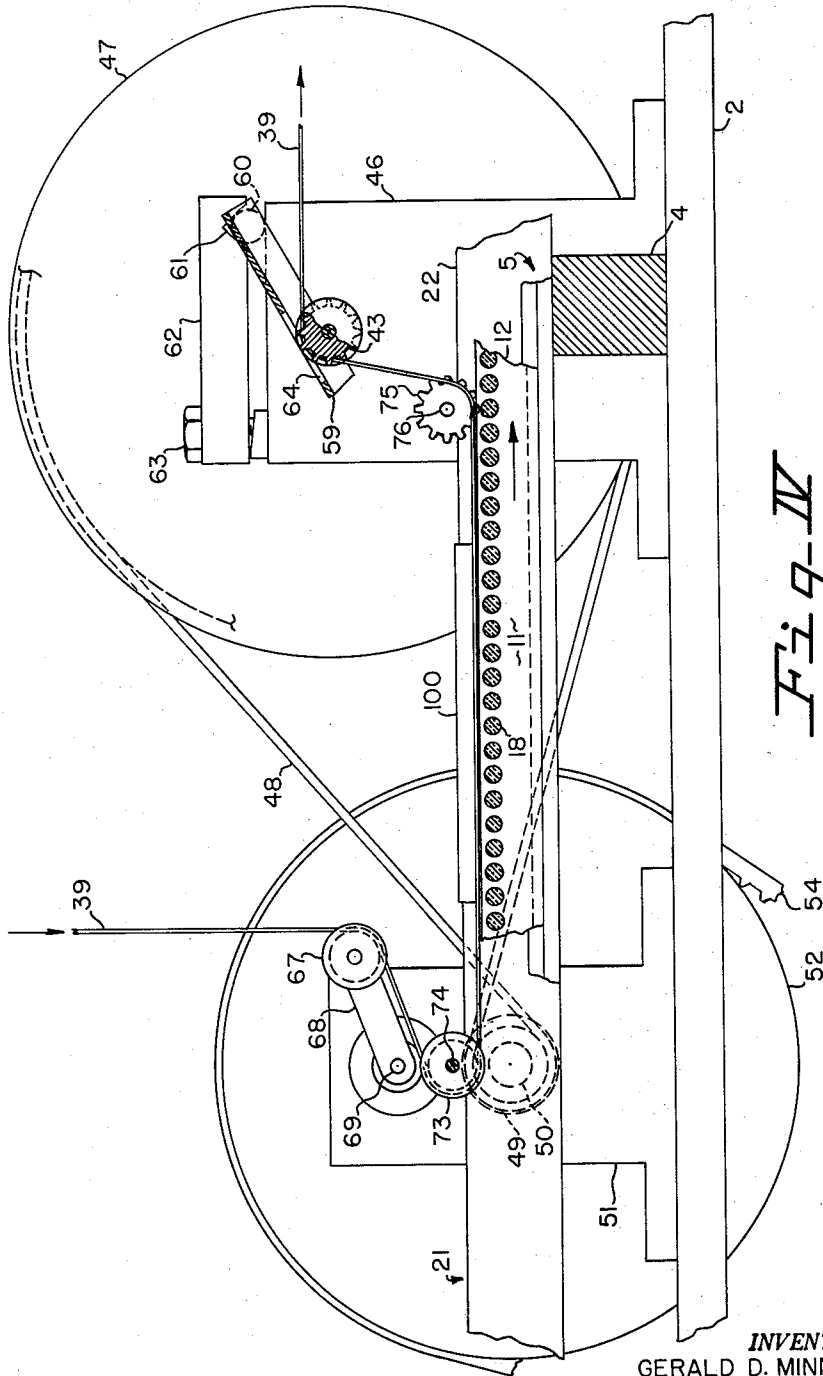


Fig. IV

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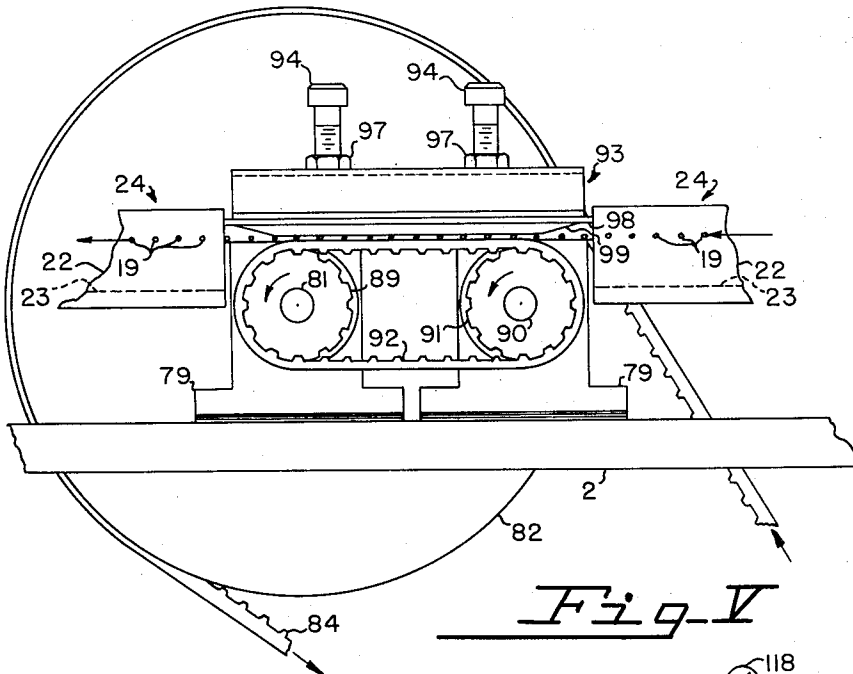


Fig. V

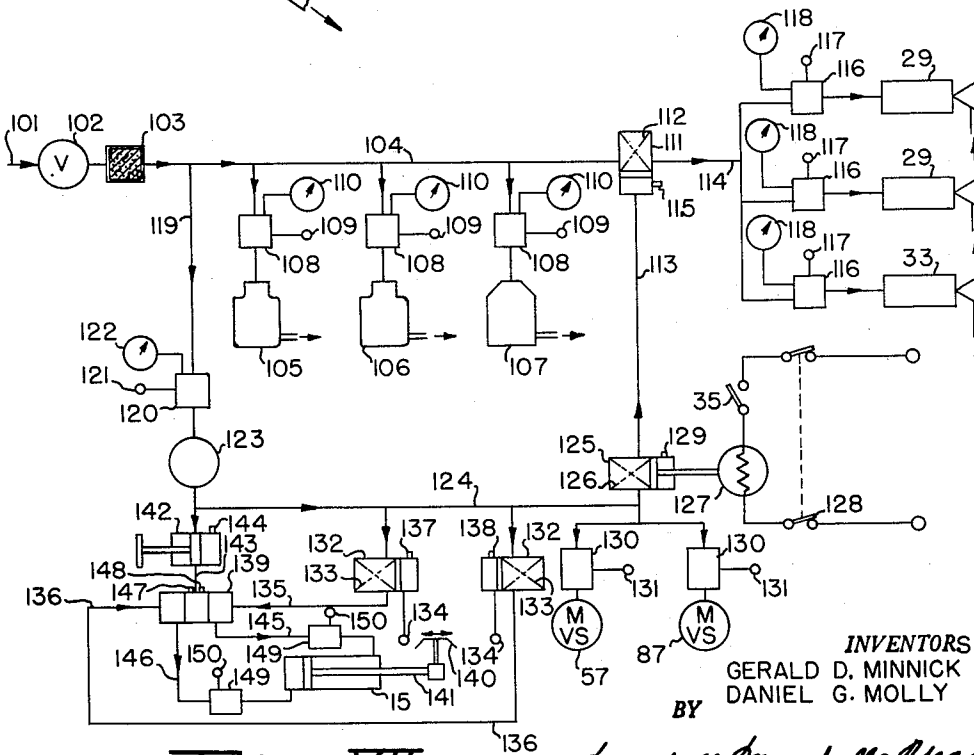


Fig. VII

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3,040,701

APPARATUS FOR SPRAY COATING SMALL ARTICLES WITH IMPROVED MASKING MEANS

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10 Claims. (Cl. 118—7)

This invention relates to coating machines.

Electrical and electronic components, such as capacitors, diodes, fuses, resistors and transistors, are covered with coating compounds which are cured to form coverings that are resistant to heat and to abrasion. Selenium diodes, for example, have electrical characteristics which vary with light intensity and are, therefore, coated with an encapsulating resinous composition, such as an epoxy compound. The coating must be so applied as to completely form a light seal. Furthermore, the coating must be very accurately applied to only the diode and very small portions of its lead wires. Otherwise, excess coating causes cracking of the coating when the wires are bent for insertion in a printed circuit board and interferes with soldering. Fuses, capacitors, resistors and transistors, for example, are coded with color bands that are protected against abrasion by means of a clear coating. All of these electrical components are small and are manufactured in great numbers. This has created problems as to the handling of these components and as to the application of these coatings.

It is, accordingly, the principal object of this invention to provide apparatus for rapidly applying coating compounds to small articles, such as electrical and electronic components.

Another object of the invention is to provide, in apparatus for spray coating small articles, improved masking means for accurately confining the coatings to selected parts only of the articles.

A further object of the invention is to provide, in apparatus for spray coating small articles, improved means for causing the coatings to be so applied as to completely and evenly cover the surfaces which it is desired to coat.

Still another object of the invention is to provide automatically operable apparatus for rapidly applying coating compounds to small articles.

Another object is to provide, in apparatus for spray coating small articles, improved means for handling such articles.

A further object is to provide apparatus for applying coating compounds to small articles, such as electrical and electronic components, while they are in curing racks.

Another object is to provide a method for applying coating compounds to small articles, such as electrical and electronic components, while they are in curing racks.

Other objects and advantages will be apparent from the following description in which reference is had to the accompanying drawings.

According to the invention, apparatus and a method are provided for automatically and rapidly applying coating compounds to small articles, such as electrical and electronic components, while they are in curing racks. This saves the step of transferring coated articles to such racks prior to a curing operation.

The loaded racks are moved through a spray station wherein selected parts only of the articles are sprayed through masking means with the coating compound. The masking means is one of the important features of the apparatus; it includes two accurately spaced perforated tapes and a drive for the tapes which continuously moves the spaced tapes through the spray station in positions juxtaposed to the articles to be sprayed. The articles are

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sprayed through the space between the tapes which confine the coatings to selected parts only of the articles.

Another important feature of the spray coating apparatus resides in a unique spinner mechanism which rotates the articles in the racks while they are being sprayed. This insures that the coatings are applied completely and evenly.

The spray coating apparatus is completely automatic. Racks carrying the articles to be coated move through the machine and the racks emerge from the machine with the articles evenly coated without the need for an operator to handle the articles or to perform any of the conveying, masking, spraying and spinning operations.

A preferred embodiment is illustrated in the accompanying drawings.

In the drawings:

FIG. I is an elevational view of the spray coating machine of the invention;

FIG. II is a plan view of the machine as seen from a position along the line II—II of FIG. I;

FIG. III is an enlarged, vertical sectional view taken substantially along the line III—III of FIG. II;

FIG. IV is a vertical sectional view taken along the line IV—IV of FIG. III;

FIG. V is a vertical sectional view taken along the line V—V of FIG. III;

FIG. VI is an enlarged, fragmentary elevational view of a curing rack as seen from a position along the line VI—VI of FIG. II; and

FIG. VII is a schematic pneumatic diagram showing the operation of the machine.

These specific figures are intended merely to illustrate the invention but not necessarily to limit its scope.

The spray coating machine includes a cabinet 1 which comprises a pair of spaced plates 2 forming its top. The plates 2 define a longitudinally extending slot 3 through the center of the cabinet top. The cabinet top supports a plurality of blocks 4 that are spaced along its entire length and that extend transversely to the longitudinal slot 3. Atop the blocks 4 are mounted two spaced and longitudinally extending angle members 5, the space between the angle members 5 being directly above the slot 3 in the cabinet top and being of about the same width as the slot 3 (FIG. III). Each of the angle members 5 includes a vertical leg 6 and a horizontal way 7 and together the angle members 5 forms a stationary track.

A gravity fed, baking rack magazine 8 is supported atop the pair of angle members 5; it includes four angle members 9 standing on end and secured to the angle members 5 and to the adjacent blocks 4, each of the angle members 9 forming a corner of the magazine 8 which is rectangularly shaped. Straps 10 about three sides of the magazine 8 give it rigidity.

Baking racks 11 are loaded into the open top of the magazine 8 and are stacked one on top of each other as shown in FIG. I. Each of the racks 11 includes a pair of angle members 12 (FIG. III) which are held together in spaced relationship by means of rivets 13 each surrounded by a spacer 14 and which are oriented to fit loosely in the stationary track provided by the angle members 5 as shown in FIG. III. An air cylinder 15 which is hung from the plates 2 of the cabinet top is operatively connected by means of an arm 16 to a pusher 17 and functions to reciprocate the pusher 17 which fits in the stationary track provided by the angle members 5 in the same manner as the baking racks. The arm 16 reciprocates in the slot 3 in the cabinet top. The broken lines to the left of the pusher 17 in FIG. I indicate that it has started moving to the right. Each time the pusher 17 moves to the right, it pushes the bottom one of the baking racks 11 in the magazine 8 out of the magazine

and along the stationary track provided by the angle members 5 and that rack pushes its neighbor along and so on, the vertical legs 6 of the angle members 5 keeping the racks 11 in a straight row as they proceed through the machine. Each time the pusher 17 moves to the left, it permits a rack 11 to fall under the influence of gravity from the open bottom of the magazine 8 onto the stationary track.

After the racks 11 are pushed out of the magazine 8 they are loaded either by machine or by hand with the articles to be coated. Alternatively, before the racks 11 are loaded into the magazine 8, the articles to be coated are loaded into the racks; this requires guide straps on the magazine in position to keep the articles from shifting sideways in the racks as the racks drop in the magazine. These guide straps are adjustable to accommodate articles to be coated of various sizes. These articles, as an exemplification only, are electrical and electronic components, such as capacitors, diodes, fuses and resistors. As a specific example, the articles are illustrated as selenium diodes one of which together with its lead wires is shown in full size in FIG. III. The diode 18 comprises a glass cylinder having concave or sunken ends into each of which a lead wire 19 is inserted. The diodes 18 have electrical characteristics which vary with light intensity and therefore are coated with an encapsulating resinous composition, such as an epoxy compound which is cured by baking. The coating must be applied evenly and completely to the glass cylinder including all of the concave surfaces at its ends to form a light seal, but must not be applied to very much of the lead wires adjacent the glass cylinder. An ideal coating extends from the glass cylinder out along the lead wires 19 a length of about one-sixteenth of an inch. If too much of the lead wires is coated, the coating will crack when the wires are bent for insertion in a printed circuit board and it interferes with soldering. The diodes 18 are loaded into the racks by placing them in notches 20 (FIG. VI) in the vertical legs of the rack angle members 12.

Atop the blocks 4 and adjacent the angle members 5 which form the stationary track are mounted two spaced and longitudinally extending angle members 21 each of which includes a vertical leg 22 (FIG. III) and a horizontal leg 23. The rear one of the angle members 21 as viewed in FIG. II is in one piece and extends from the magazine 8 to the discharge or right end of the machine. The front one of the angle members 21 is in two sections 24 one of which extends from the magazine 8 to a spray station 25 and the other one of which extends from the spray station 25 to the discharge end of the machine, the ends of the section 24 at the spray station 25 being spaced apart as shown in FIG. II. The angle members 21 function as guide rails for the diodes 18, the vertical legs 22 of the angle members 21 contacting the tips of the lead wires 19 of the diodes and preventing lateral shifting of the diodes as they are conveyed along the stationary track. One of the angle members 21 can be seen in FIG. III contacting the right hand lead wire 19. The other one of the angle members 21 cannot be seen in FIG. III because FIG. III is a section taken through the area in which the ends of the sections 24 of the front one of the angle members 21 are spaced apart. Means, hereinafter described, are utilized to prevent lateral shifting of the diodes 18 to the left in the spray station 25 as viewed in FIG. III.

A pair of angle members 26 each having a foot 27 (FIG. II) is mounted by means of the feet atop the plates 2 of the cabinet top at the spray station 25. Between the angle members 26 there extends a rod 28 from which is hung a pair of conventional air blast sprayers or spray guns 29. The spray guns are so positioned that each one directs its spray toward the surfaces of the diodes 18 to be coated. Suitable exhaust equipment filters and discharges fumes through a stack which communicates with a discharge port 30 in the rear wall of

the cabinet 1 to maintain an atmosphere free from coating compounds. These fumes pass through the slot 3 in the cabinet top as seen in FIG. III into an exhaust chamber 31 the left limits of which as viewed in FIG. I is defined by a partition 32 and then out of the port 30. A third air blast sprayer or ordinary spray gun 33 is mounted on an inverted L-shaped rod 34 atop the cabinet 1 at the discharge end of the cabinet; it functions to spray one end only of the diode lead wires with a compound by means of which one end of each of the diodes later can be identified from the other, the diodes being sent through the machine in a particular end orientation.

The three spray guns 29 and 33 are turned on and off automatically by means including an explosion-proof normally open micro switch 35 having an operating roller arm 36, that is operated by the baking racks 11. The upper edges of the racks 11 function as cams, each end of each of the racks 11 having a dwell portion 37 and each of the racks 11 having a high or operating portion 38 between its dwell portions. The notches 20 in the racks 11 which carry the diodes to be coated are located along the operating portions 38 only. When the roller arm 36 rides on the operating cam portion 37 of one of the racks 11 the normally open micro switch 35 is held closed and the three guns 29 and 33 spray. While the roller arm 36 is on a dwell cam portion 37 at the beginning or at the end of a rack 11 the guns are stopped. Hence, as the pusher 17 reciprocates and moves the racks along the stationary track the spray guns automatically are turned on and off. The apparatus, of course, is so proportioned that the notched, diode carrying portions of the racks 11 are located beneath the spray guns 29 during the time that such guns are spraying. That is, whenever the roller arm 36 rides on the operating cam portion 38 of one of the racks, a similar portion of another rack is located beneath the spray guns 29 and the spraying takes place while the racks are moving.

One of the important features of the spray coating machine resides in its masking means for accurately confining the coating to selected parts only of the electrical or electronic components. In the case of the illustrated diodes, such selected parts include all of the glass cylinder of each of the diodes, including the concave surfaces at the ends, but only about one-sixteenth of an inch of each of the lead wires 19 adjacent such cylinder.

The masking means includes a pair of paper tapes 39 each of which has a series of perforations 40 along an edge and which resemble motion picture film. In fact, motion picture film could be substituted, except for its high cost, for the tapes 39. The tapes 39 are supplied to the machine from rolls on reels 41 which are rotatably mounted, slightly spaced apart and side by side on a shaft 42 which extends between the upper ends of the angle members 26. Only one of the reels 41 can be seen in FIG. I but they are identical; their spacing is indicated by the space between the tapes 39 shown in FIG. III. The tapes 39 are drawn from the reels 41 slow enough and there is enough friction at the reels 41 to prevent overrun of the reels caused by inertia. The tapes 39 are so oriented as shown in FIG. III that the series of perforations 40 on each of the tapes is remote from the space which separates the tapes.

Each of the tapes 39 is pulled from its reel 41 by means of a drive sprocket 43 the teeth of which mesh with the perforations 40 in the tape. The drive sprockets 43 are mounted side by side on a common shaft 44 so that they turn as one. One end of the shaft 44 is journaled in a bearing block 45 atop the cabinet 1 and the other end of the shaft 44 is journaled in and extends through a bearing block 46 also atop the cabinet 1, there being a sheave 47 fixed to the extended end of the shaft 44 which is driven by means of a spring wire 48 on a pulley 49 that is secured to a shaft 50 journaled in a bearing block 51 which also is atop the cabinet 1. A timing gear 52 is secured to the end of the shaft 50 and it is located in an

opening 53 in one of the plates 2 of the cabinet top; it is driven by means of a timing belt 54 that runs on a small timing gear 55 which turns as one with a large timing gear 56 that in turn is driven by means of a rotary positive displacement air motor 57 through a timing belt 58. The several timing belts 54 and 58 and their associated gears provide suitable speed reduction. It is immaterial just what drive system is employed as long as some means is provided for turning the drive sprockets 43 in a direction to move the tapes 39 to the right as viewed in FIG. II. The speed of the drive should be adjustable so that minimum amounts of the tapes are used up while still producing work of the highest quality. Means for adjusting the speed of the air motor 57 will be described hereinafter.

Each of the tapes 39 is kept from coming off of its drive sprocket 43 by means of a hold down member 59 (FIG. IV) which bears upon the tape at the drive sprocket. One of the hold down members 59 is secured to a rod 60 (FIG. IV) which is held in a notch 61 in the bottom of a clamp 62 and against the top of the bearing block 46. The clamp 62 is held in place by means of a screw 63; when the screw 63 is loosened the rod 60 can be pivoted about its axis to adjust the pressure of the hold down member 59 on the tape 39. An opening 64 in the hold down member 59 allows the teeth on the drive sprocket 43 to turn freely. The other one of the hold down members 59 (FIG. I) is adjustably mounted in a similar manner from the bearing block 45 by means including a rod 65 and a clamp 66 (FIG. I). Both of the hold down members 59 are identical in structure and in function.

The tapes 39 are pulled downwardly from their reels 41 in a vertical direction. Each of the tapes 39 is guided over an idler pulley 67 one of which is rotatably mounted on the end of an arm 68 that is secured to a shaft 69 journaled in the bearing block 51 and the other one of which is rotatably mounted on the end of an arm 70 that is secured to a shaft 71 journaled in a bearing block 72 atop the cabinet 1. The idler pulleys 67 bear upon the tapes 39 under the influence of gravity to keep the tapes tracking as they leave the reels 41 in the paths indicated in FIG. I. The idler pulleys 67 can be spring urged against the tapes if this is found necessary. Each of the tapes 39 then is guided over an idler pulley 73 which are both rotatably mounted side by side on a common shaft 74 which extends between the bearing blocks 51 and 72. The pair of idler pulleys 67 is located on the opposite sides of the tapes 39 to the pair of idler pulleys 73.

Each of the tapes 39 then is guided over a guide sprocket 75 one of which is secured to a shaft 76 journaled in the bearing block 46 and the other one of which is secured to a shaft 77 journaled in the bearing block 45. The tapes 39 between the idler pulleys 73 and the guide sprockets 75 are maintained in straight horizontal runs slightly spaced from the upper surfaces of the baking racks 11 and juxtaposed as best shown in FIGS. III and IV to the diodes 18 in the spray station 25. As shown in FIG. III, the guns 29 spray the coating compound through a space 78 between the continuously moving tapes 39, the tapes masking most of the diode lead wires 19 from the spray. An adjustment of the width of the space 78 and the positions of the guns 29 varies the extent to which the lead wires 19 are coated. The tapes 39 are moved continuously to prevent any substantial build up of coating material on the tapes so that sharp masking edges are provided. However, the tapes 39 are not moved as fast as the baking racks 11. The speed of the tapes 39 is simply kept as low as possible consistent with the production of high quality work to keep tape usage at a minimum. There is thus provided a masking means of low cost that is continuously renewed and which is accurately located in the spray station 25 to produce high quality work consistently, reproducibly and automatically.

As illustrated in FIG. II, the guide sprockets 75 are

offset from the drive sprockets 43 to an extent such that only the teeth of the guide sprockets contact the tapes 39. This is an important feature. As viewed in FIG. II, the upper surfaces of the tapes 39 at their edges along the space between the tapes are wet with the coating compound when the tapes reach the guide sprockets 75. However, since only the teeth of the guide sprockets 75 contact the tapes 39 and that contact being along the edges of the tapes remote from where the spray was directed onto the tapes, the guide sprockets stay free of coating compound which otherwise would soon build up and render them inoperative. It is immaterial that the tapes run over all of the drive sprockets 43 as viewed in FIG. II because the wet sides of the tapes are the upper sides of the tapes as seen in FIG. II and it is the dry underneath sides of the tapes which contact the drive sprockets 43.

The perforations 40 in the tapes 39 also are very important. For one thing, it is by means of the perforations that accurate lateral alignment of the tapes through the spray station 25 is maintained. For another thing, it is possible by means of the perforations and the guide sprockets 75 which cooperate therewith to keep the tapes close to the diodes 18 in the spray station 25 without the wet coating getting on the guide sprockets as hereinbefore described.

Another of the important features of the spray coating machine resides in a spinner mechanism which rotates the diodes in the baking racks 11 while they are being sprayed. This insures that the coatings are applied completely and evenly.

The spinner mechanism includes a pair of bearing blocks 79 carried by the left hand one of the plates 2 of the cabinet top as viewed in FIG. III one of which blocks is provided with bearings 80 that journal a drive shaft 81 which extends from the bearing block on both of its sides. On the left hand end of the drive shaft 81 as seen in FIG. III there is secured a timing gear 82 which is located in an opening 83 in such left hand one of the plates 2; it is driven by means of a timing belt 84 that runs on a small timing gear 85 which turns as one with a large timing gear 86 that in turn is driven by means of a rotary positive displacement air motor 87 through a timing belt 88. The several timing belts 84 and 88 and their associated gears provide suitable speed reduction. It is immaterial just what drive system is employed as long as some means is provided for turning the drive shaft 81. The speed of the drive must be adjustable to keep from bending the diode lead wires 19 one way or the other as hereinafter described. Means for adjusting the speed of the air motor 87 will be described hereinafter.

On the right hand end of the drive shaft 81 as seen in FIG. III there is secured a timing gear 89. A shaft 90 is journaled in the right hand one of the bearing blocks 79 as viewed in FIG. V, there being an idler timing gear 91 secured to the free end of the shaft 90. The shafts 81 and 90 are in horizontal alignment and the gears 89 and 91 are of the same size. A spinner timing belt 92 runs around the timing gears 89 and 91 and is located in the spray station 25 at an elevation to contact the underneath surfaces of the diode lead wires 19 as they are moved through the spray station.

Atop the bearing block 79 there is adjustably mounted a shoe 93 by means including four screws 94 two of which are threaded into the top of one of the bearing blocks 79 and two of which are threaded into the top of the other one of the bearing blocks 79. Lock nuts 95 hold the screws 94 in adjusted positions. The shoe 93 bears on a pair of nuts 96 on the two screws 94 remote from the tapes 39 and is held in such position by means of two nuts 97 on the other screws 94. The shoe 93 can be raised or lowered by adjusting the nuts 96 and 97. Also, since the shoe 93 has a loose fit on the screws 94, it can be tilted in several directions by adjusting the nuts

96 and 97. As viewed in FIG. III, the right hand side of the shoe 93 can be raised or lowered with respect to its left hand side and, as viewed in FIG. V, one end of the shoe 93 can be raised or lowered with respect to the other.

The shoe 93 includes an angle member 98 secured to its free end and a resilient member 99, made of material such as rubber, secured to the angle member 98. The angle member 98 fills in the space between the sections 24 of the angle members 21 as shown in FIG. V, and can be pictured as a part of the sections 24, since it has the same function. That is, the angle members 21 as hereinbefore described function as guide rails for the diodes 18, the vertical legs 22 of the angle members 21 contacting the tips of the diode lead wires 19 and preventing lateral shifting of the diodes as they are conveyed along the stationary track. In the spray station 25, as shown in FIGS. III and V, lateral shifting of the diodes 18 to the left as viewed in FIG. III is prevented by contact of the tips of the diode lead wires 19 with the lower margin of the vertical portion of the angle member 98. The distance between the angle members 21 is varied to accommodate articles to be coated of various sizes. Any such adjustment of the positions of the sections 24 of the angle members 21 requires a like adjustment of the positions of the spinner bearing blocks 79 to locate the angle member 98 in alignment with such sections 24.

The resilient member 99 of the shoe 93 is so positioned that its bottom surface is parallel to the upper surface of the timing belt 92 and only slightly spaced therefrom. The left hand ends of the diode lead wires 19 as viewed in FIG. III are caught between the stationary resilient shoe member 99 and the moving upper surface of the timing belt 92 and are thus rotated in the baking racks 11 while they are moved through the spray station 25 and while they are being sprayed. This insures that the coatings are applied completely and evenly. The right hand ends of the diode lead wires 19 are held down while they are being rotated by means of a stationary hold down member or shoe 100 which is secured to the vertical leg 22 of the angle member 21. The timing belt 92 is turned so that its upper flight moves in the same direction as the direction of travel of the baking racks 11 and at a speed such that the peripheral speeds of the diode wires are the same as the baking racks to prevent bending of the lead wires.

The spray coating apparatus is completely automatic. Baking racks carrying the articles to be coated move through the machine and the racks emerge from the machine with the articles evenly coated ready to be put into an oven without the need for an operator to handle the articles or to perform any of the conveying, masking, spraying and spinning operations. One of the features resides in the method of coating the articles while they are in the baking racks. This eliminates the step of transferring coated articles to such racks prior to the baking process.

In operation with reference to FIG. VII, compressed air is supplied to the machine from a suitable source through a line 101 which takes the air through a valve 102 and a filter 103. Clean air flows through a line 104 from the filter to supply pressure to tanks 105, 106 and 107. Pressure in the tanks is regulated by means of air regulators 108 controlled by knobs 109 and connected to gauges 110. Tanks 105 and 106 contain coating compound which is supplied under pressure to the guns 29 as is indicated by the arrows at the bottoms of the tanks and by the arrows at the nozzles of the guns. Tank 107 contains coating compound which is supplied under pressure to the gun 33 as is indicated by the arrow at the bottom of the tank and by the arrow at the nozzle of the gun.

Clean air also flows through the line 104 to a normally closed 3-way pilot valve 111. The valve 111 is normally held closed by means of a spring 112 and is opened by

means of air flow from a line 113. A pilot valve which is operated by air in one direction and by a spring in the other direction is shown in detail in FIG. VI in U.S. Patent No. 2,795,206 issued on June 11, 1957 to E. L. Faber. When the valve 111 is closed, air exhausts from a line 114 through a valve port 115. When the valve 111 is open, clean air from the line 104 passes through the valve 111 and through the line 114 to the guns 29 and 33. This air is both trigger air and atomizing air and its pressure is regulated for each of the guns by means of air regulators 116 controlled by knobs 117 and connected to gauges 118.

Air also flows from the filter 103 through a line 119 to an air regulator 120 controlled by a knob 121 and connected to a gauge 122 from whence it flows to an air line lubricator 123. From the lubricator 123, air flows through a line 124 to a normally closed, 3-way solenoid operated valve 125 (explosion proof). The valve 125 is normally held closed by means of a spring 126 and is opened by means of a solenoid 127 which is an electrical circuit with the micro-switch 35. The 3-way valve 125 is like the 3-way pilot valve 111, except whereas the pilot valve 111 is air operated the 3-way valve 125 is solenoid operated. When a manually operated main switch 128 in the electrical circuit is closed and the normally open micro-switch 35 is held closed by a baking rack 11 as hereinbefore described, the operated coil of the solenoid 127 is energized and the normally closed 3-way valve 125 is opened. Air then flows from the valve 125 through the line 113 to the normally closed valve 111 which is thereupon opened to admit the clean air from the line 104 to the guns 29 and 33. When the valve 125 is closed, air exhausts from the line 113 through a valve port 129. Hence, whenever a baking rack 11 closes the micro-switch 35 all three of the guns spray for as long as the micro-switch 35 is held closed. The guns can be stopped at any time by either removing the baking rack which happens to be holding the micro-switch 35 closed or by opening the main switch 128.

Air also flows through the line 124 to the rotary positive displacement air motors 57 and 87. The speeds of the motors 57 and 87 are varied by means of valves 130 which adjustably restrict the flow of air to the motors. The valves 130 are controlled by means of manually operated knobs 131.

Air also flows through the line 124 to a pair of identical, normally closed, 3-way valves 132. The valves 132 are normally held closed by means of springs 133 and are opened by means of mechanically operated rollers 134. The 3-way valves 132 are like the 3-way pilot valve 111, except whereas the pilot valve 111 is air operated the 3-way valves 132 are mechanically operated. When the valves 132 are closed, air exhausts from lines 135 and 136 through valve ports 137 and 138, respectively. When the left hand valve 132 as viewed in FIG. VII is open, air from the line 124 flows through such valve and through the line 135 to one side of a 4-way valve 139. When the other one of the valves 132 is open, air from the line 124 flows through such valve and through the line 136 to the other side of the 4-way valve 139. The rollers 134 of the valves 132 are operated by means of a cam 140 which is carried by the piston rod 141 of the air cylinder 15. One of the rollers 134 is operated by the cam 140 at one end of the stroke of the piston rod 141 to open momentarily its normally closed valve 132 and the other one of the rollers 134 is operated by the cam 140 at the other end of the stroke of the piston rod 141 to open momentarily its normally closed valve 132. Opening of the valves 132 causes reversal of the piston rod 141 and the length of the piston rod's stroke is varied by changing the distance between the valves 132. Air to operate the cylinder 15 is admitted to the 4-way valve 139 from a manually operated 3-way valve 142 which receives air from the lubricator 123 the opening and closing of which valve 142 starts and stops operation of the cylinder 15.

When the manually operated valve is closed, air exhausts from a line 143 through its port 144. When the manually operated valve 142 is open, air flows from such valve through the line 143 to the 4-way valve 139.

As long as the manually operated valve 142 is open, air flows to the 4-way valve 139 from the line 143 through such valve 139 and through either a line 145 or a line 146 to the air cylinder 15 to keep the air cylinder continuously in operation. As the cam 140 reaches the right hand end of its path as viewed in FIG. VII, air flow from the momentarily opened right hand valve 132 through the line 136 so operates the 4-way valve 139 that air flows from the line 143 through the 4-way valve 139 and through the line 145 to the cylinder 15 to reverse the direction of the piston rod 141 and move it toward the left and air is exhausted from the line 146 through a valve port 147. As the cam 140 reaches the left hand end of its path, air flow from the momentarily opened left hand valve 132 through the line 135 so operates the 4-way valve 139 that air flows from the line 143 through the 4-way valve 139 and through the line 146 to the cylinder 15 to reverse the direction of the piston rod and move it toward the right and air is exhausted from the line 145 through a valve port 143. Flow control valves 149 having manually operated knobs 150 control the flow of air to and from the cylinder 15. The valves 149 permit full flow to the cylinder 15 through lines 145 and 146 and adjustably meter the exhausted air flow from the cylinder through lines 145 and 146 to control the speed of the cylinder's piston rod 141.

Various modifications may be made in specific details of construction without departing from the spirit and scope of the invention.

Having described the invention, we claim:

1. In a machine for coating selected portions of small articles, such as electrical and electronic components, in combination, a coating station, a track through the coating station, a plurality of racks each for carrying a group of the articles and each including came means, means for moving the racks and the articles carried thereby along the tracks through the coating station, masking means for confining coatings to the selected portions of the articles, means for moving the masking means through the coating station adjacent the articles in the coating station, means for rotating the articles in the racks while the rack are in the coating station, coating means so located in the coating station as to direct coating compound through the masking means onto the selected portions of the articles while the articles are being rotated in and moved through the coating station and while the masking means is being moved through the coating station, and means responsive to said cam means for automatically turning the coating means on whenever the articles are moved past the coating means and for automatically turning the coating means off whenever the articles cease being moved past the coating means.

2. In a machine for coating selected portions of small articles, such as electrical and electronic components, in combination, a coating station, a track through the coating station, a gravity fed magazine located above the track, a plurality of racks each for carrying a group of the articles and each including cam means and which are loaded into the magazine, means for moving the racks out of the magazine and along the track through the coating station, masking means for confining coating to the selected portions of the articles, means for moving the masking means through the coating station adjacent the articles in the coating station, means for rotating the articles in the racks while the racks are in the coating station, coating means so located in the coating station as to direct coating compound through the masking means onto the selected portions of the articles while the articles are being rotated in and moved through the coating station and while the masking means is being moved through the coating station, and means responsive to said cam means for

automatically turning the coating means on whenever the articles are moved past the coating means and for automatically turning the coating means off whenever the articles cease being moved past the coating means.

3. In a machine for coating selected portions of small articles, such as electrical and electronic components, in combination, a coating station, a track through the coating station, a plurality of racks each for carrying a group of the articles and each including cam means, each rack having a series of notches in which are articles are carried and in which the articles are freely rotatable, means for moving the racks and the articles carried thereby along the track through the coating station, masking means for confining coating to the selected portions of the articles, means for moving the masking means through the coating station adjacent the articles in the coating station, means for rotating the articles in the racks while the racks are in the coating station, coating means so located in the coating station as to direct coating compound through the masking means onto the selected portions of the articles while the articles are being rotated in and moved through the coating station and while the masking means is being moved through the coating station, and means responsive to said cam means for automatically turning the coating means on whenever the articles are moved past the coating means and for automatically turning the coating means off whenever the articles cease being moved past the coating means.

4. In a machine for spray coating selected portions of small articles, such as electrical and electronic components, in combination, a spray station, means for moving the articles through the spray station, a pair of tapes for confining coatings to the selected portions of the articles, a series of perforations along a margin of each of the tapes, supply means for supplying the tapes to the machine in an orientation in which the tapes are separated by a space and in which the perforations are remote from such space, drive sprocket means which cooperate with the perforations in the tapes for pulling the tapes from the tape supply means through the spray station adjacent the articles in the spray station, means for driving said sprocket means, idler guide sprocket means at the spray station having teeth which cooperate with the perforations in the tapes for maintaining lateral alignment of the tapes through the spray station, the guide sprocket means being so offset from the tapes that the tapes contact only the teeth of the guide sprocket means, means for rotating the articles while they are in the spray station, and spraying means so located in the spray station as to direct coating compound through the space between the tapes onto the selected portions of the articles while the articles are being rotated in and moved through the spray station and while the tapes are being moved through the spray station, said contact of the teeth only of the guide sprocket means with the tapes keeping the guide sprocket means free of coating compound with which the tapes are wet at the spray station.

5. A machine for coating selected portions of articles comprising, in combination, coating means, conveying means for moving the articles past the coating means, means for varying the speed of the conveying means, masking means for confining coating to the selected portions of the articles, mask driving means for moving the masking means past the coating means adjacent the articles being moved past the coating means, means for varying the speed of the mask driving means, spinner means for rotating the article while they are moved past the coating means, means for varying the speed of the spinner means, the coating means being so oriented as to direct coating compound through the masking means onto the selected portions of the articles while the articles are being rotated, and means for automatically turning the coating means on whenever articles are moved past the coating means and for automatically turning the coating means

off whenever articles cease being moved past the coating means.

6. In a machine for coating articles, in combination, a coating station, means comprising a plurality of racks each for moving a group of the articles through the coating station in a substantially horizontal path and each including cam means, means for rotating the articles in the racks while the racks are in the coating station, coating means for applying coating compound to the rotating articles in the coating station, and means responsive to said cam means for automatically turning the coating means on whenever the articles are moved past the coating means and for automatically turning the coating means off whenever the articles cease being moved past the coating means.

7. In a machine for spray coating selected portions of small articles, in combination, a spray station, conveyor means for moving the articles through the spray station, masking means for confining coatings to the selected portions of the articles, means for moving the masking means through the spray station adjacent the articles in the spray station, means in the spray station, including a stationary shoe and a moving belt between which portions of the articles are passed, for rotating the articles while they are moved through the spray station, and means for spraying coating compound through the masking means onto the selected portions of the articles while the articles are being rotated.

8. In a machine for spray coating selected portions of small articles, in combination, a spray station, conveyor means for moving the articles through the spray station, masking means for confining coatings to the selected portions of the articles, means for moving the masking means through the spray station adjacent the articles in the spray station, means in the spray station, including a first stationary shoe and a moving belt between which portions of the articles are passed, for rotating the articles while they are moved through the spray station, guide means in the spray station for preventing lateral shifting of the articles as they are moved through the spray station, a second stationary shoe transversely spaced from the first shoe relative to the path of the articles through the spray station for holding the articles in the conveyor means as they are rotated, and means for spraying coating compound through the masking means onto the selected portions of the articles while the articles are being rotated in and moved through the spray station and while the masking means is being moved through the spray station.

9. In a spray coating machine, in combination, a spray station, means for moving articles to be coated through the spray station, a tape for confining coatings to certain areas, a series of perforations in the tape, tape supply means, drive sprocket means which cooperates with

the perforations in the tape for pulling the tape from the tape supply means through the spray station adjacent the articles in the spray station, a guide sprocket at the spray station having teeth which cooperate with the perforations in the tape, the guide sprocket being so offset from the tape that the tape contacts only the teeth of the guide sprocket, and spraying means so located in the spray station as to direct coating compound onto the articles along a line defined by an edge of the tape, said contact of the teeth only of the guide sprocket with the tape keeping the guide sprocket free of coating compound with which the tape is wet at the spray station.

10. In a spray coating machine, in combination, a spray station, means for moving articles through the spray station, a pair of tapes for confining coatings to selected portions of the articles, a series of perforations along a margin of each of the tapes, supply means for supplying the tapes to the machine in an orientation in which the tapes are separated by a space and in which the perforations are remote from such space, drive sprocket means which cooperate with the perforations in the tapes for pulling the tapes from the tape supply means through the spray station adjacent the articles in the spray station, means for driving said sprocket means, idler guide sprocket means at the spray station having teeth which cooperate with the perforations in the tapes for maintaining lateral alignment of the tapes through the spray station, the guide sprocket means being so offset from the tapes that the tapes contact only the teeth of the guide sprocket means, and spraying means so located in the spray station as to direct coating compound through the space between the tapes onto the selected portions of the articles, said contact of the teeth only of the guide sprocket means with the tapes keeping the guide sprocket means free of coating compound with which the tapes are wet at the spray station.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No, 3,040,701

June 26, 1962

Gerald D. Minnick et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 9, line 17, for "lef" read -- left --; line 28, for "exhausted" read -- exhaust --; line 39, for "came" read -- cam --; line 45, for "rack" read -- racks --; line 65, for "coating" read -- coatings --; column 10, line 10, for "are", first occurrence, read -- the --; line 14, for "coating" read -- coatings --.

Signed and sealed this 4th day of December 1962.

(SEAL)

Attest:

ERNEST W. SWIDER
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