PUBLISHED

A. B. ST. HILAIRE

Serial No.

MAY 4, 1943. APPARATUS FOR MANUFACTURING PHONOGRAPHIC DISCS 343,178

BY A. P. C.

Filed June 29, 1940

6 Sheets-Sheet 1

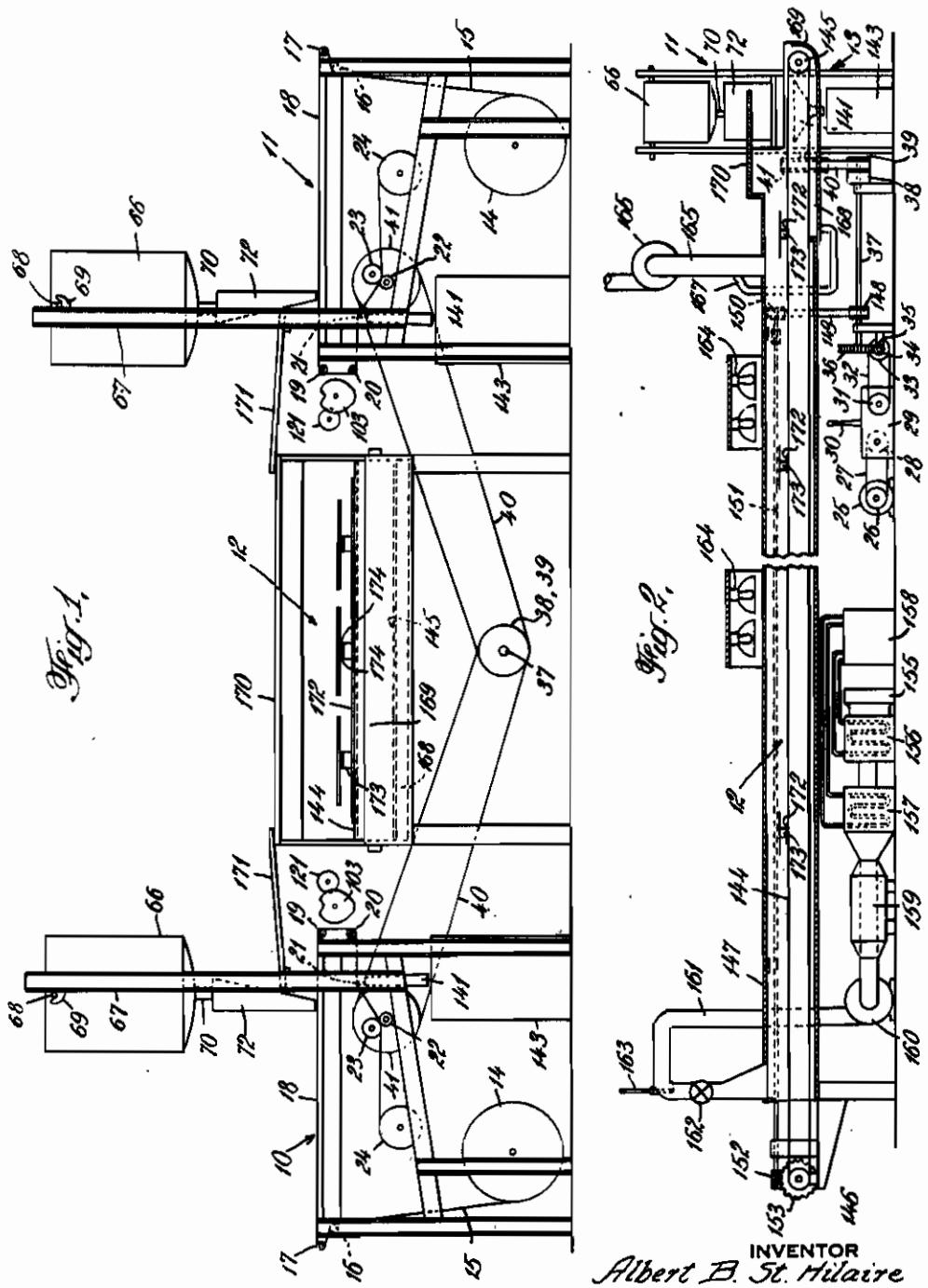

Fig. 1.

Fig. 2.

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Fig. 3,

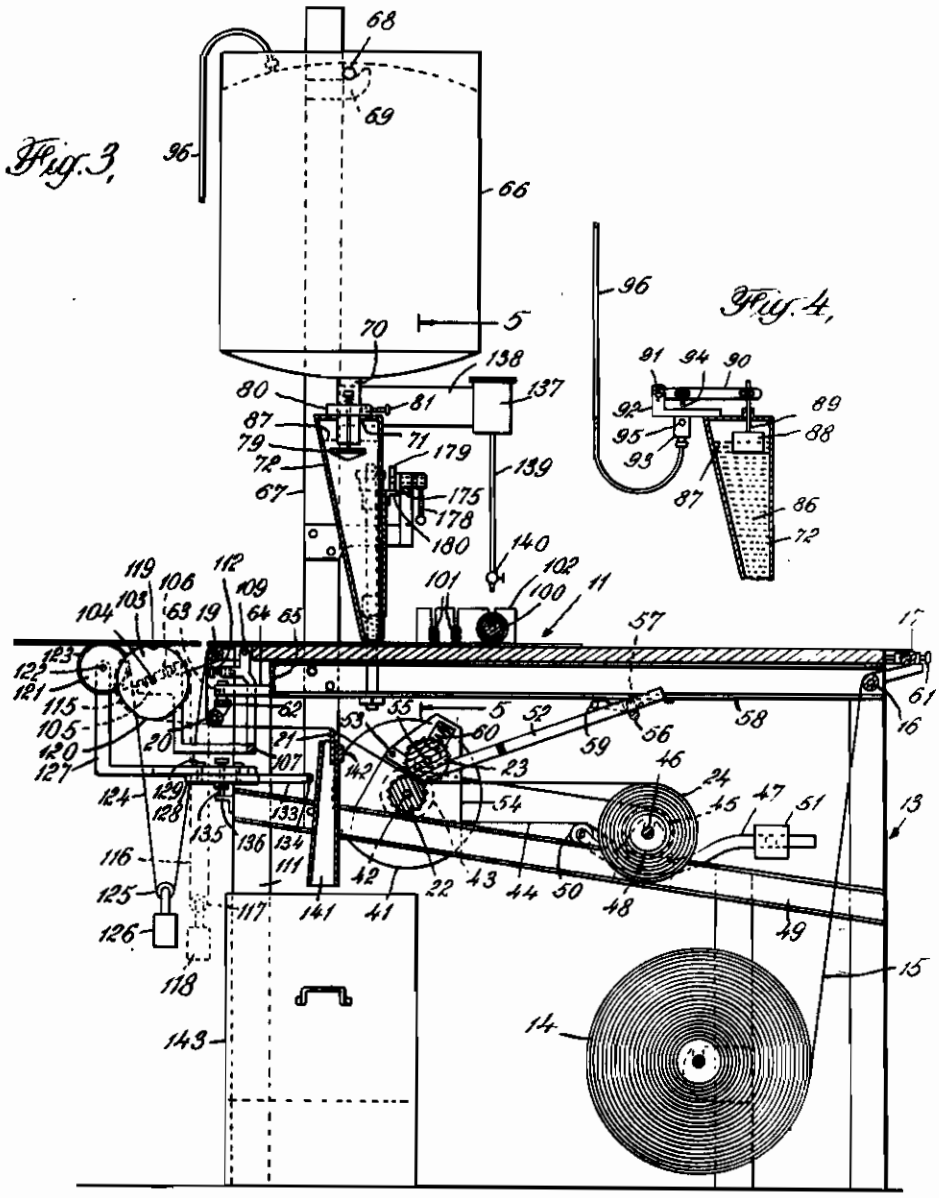

Fig. 4,

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Fig. 5,

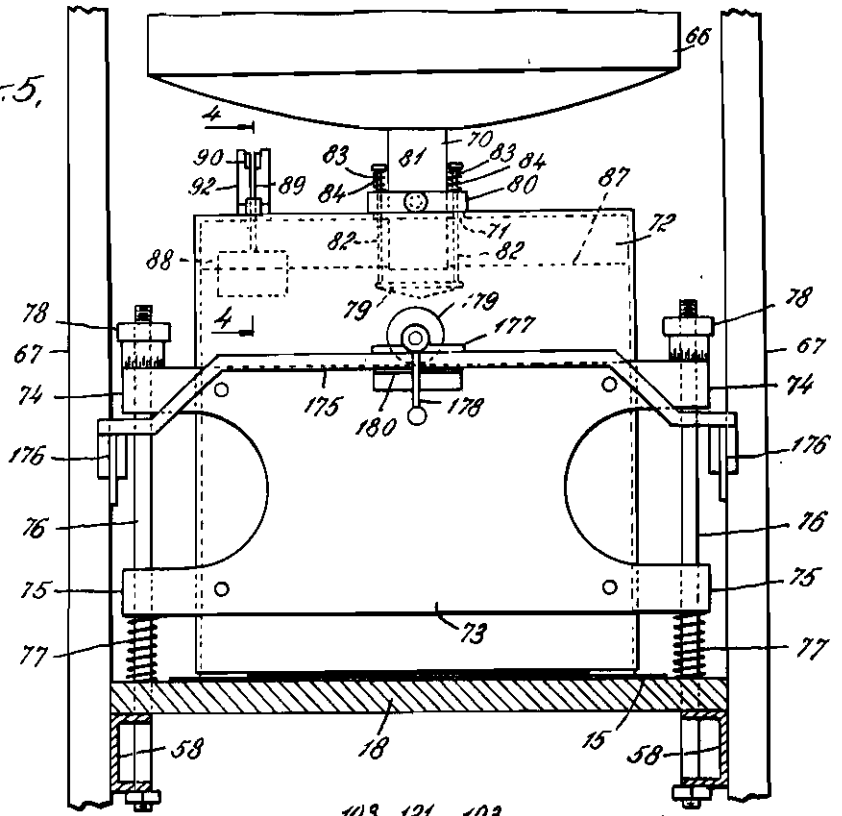

Fig. 6,

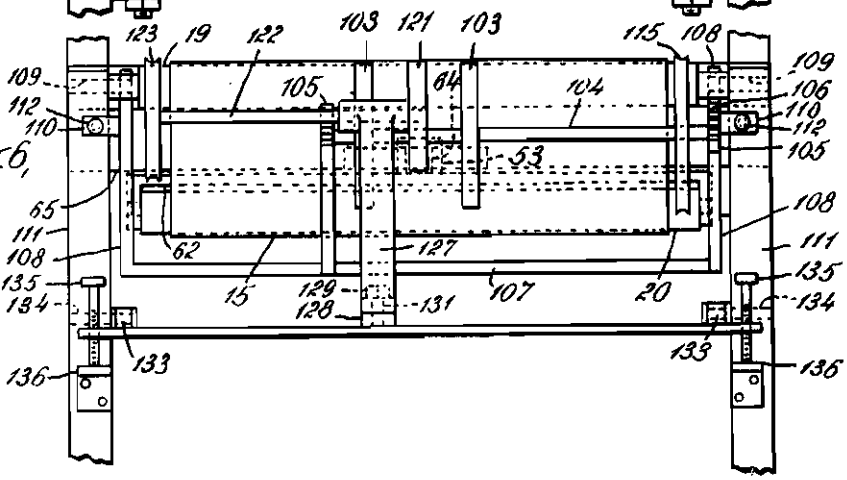

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Fig. 7.

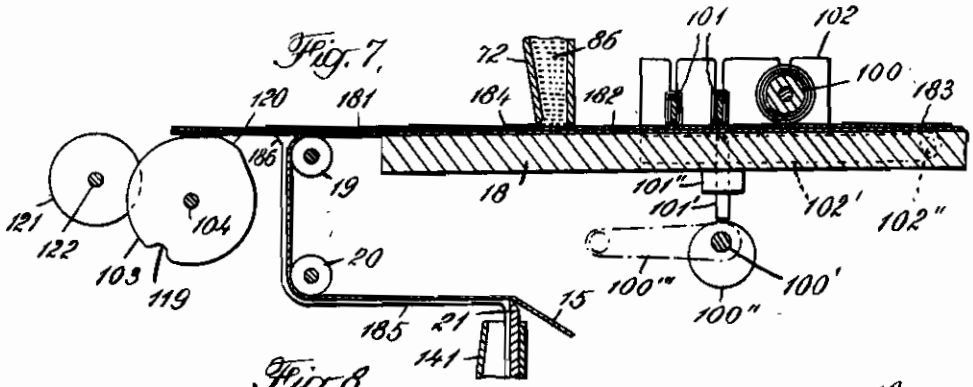

Fig. 8

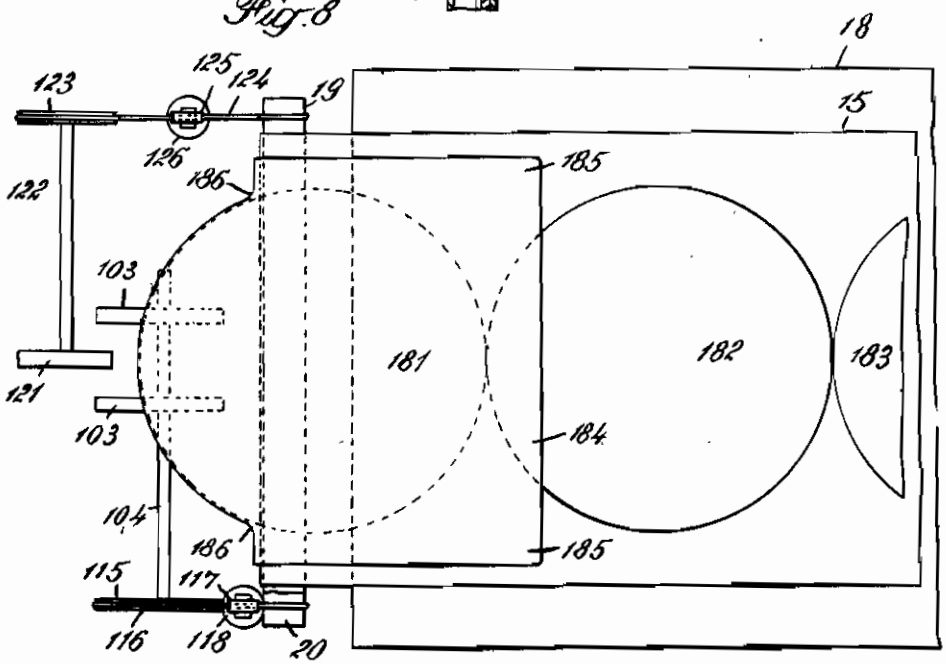

Fig. 9.

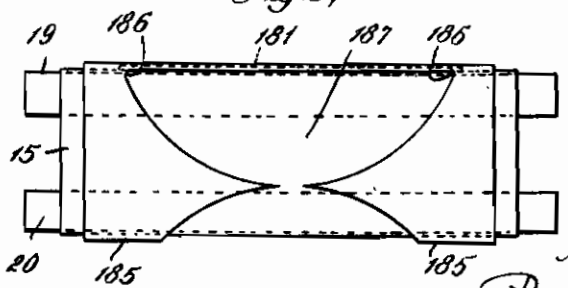

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Fig. 10

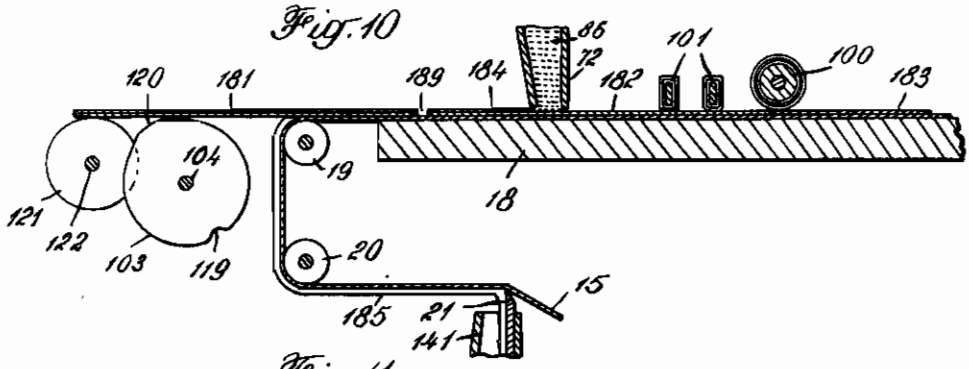

Fig. 11

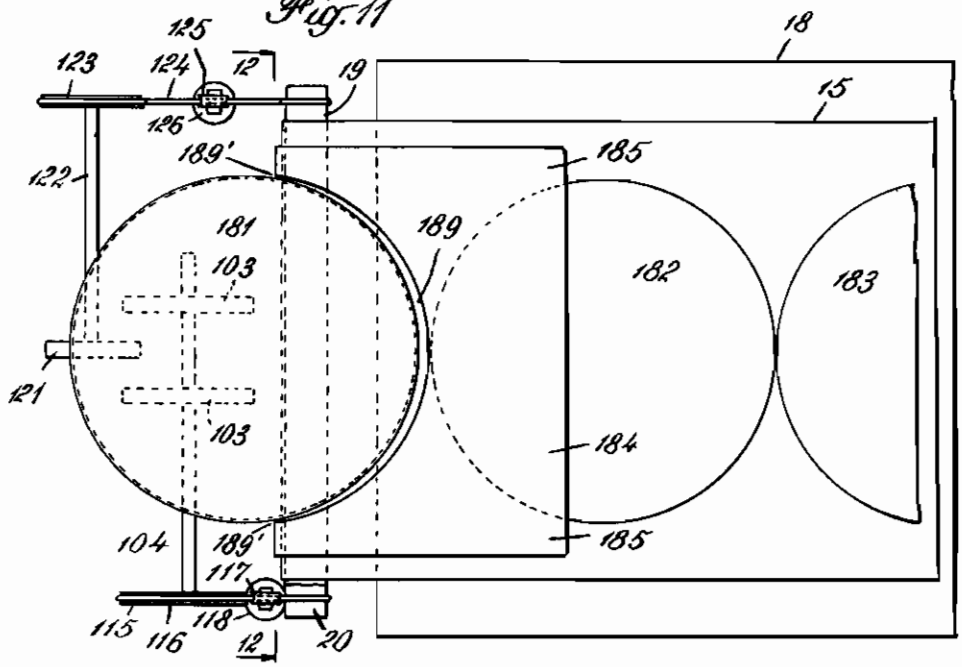

Fig. 12.

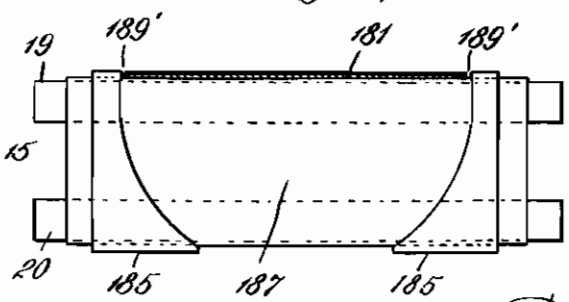

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Fig. 13,

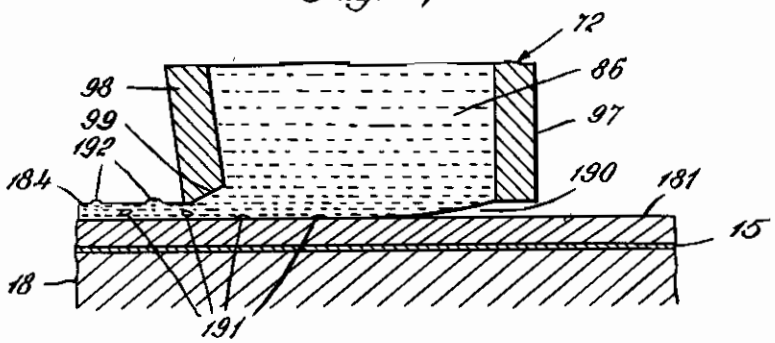


Fig. 14,

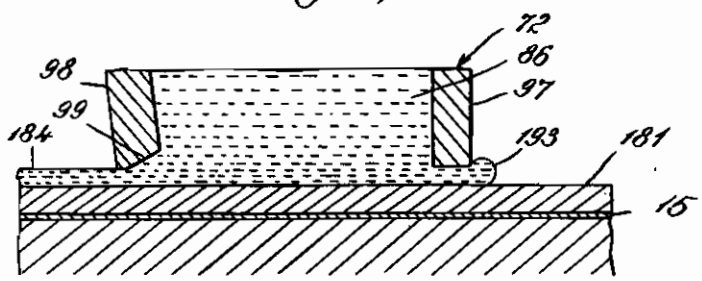
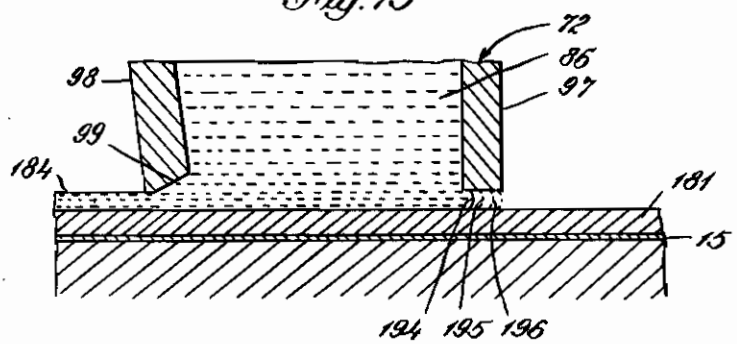


Fig. 15



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ALIEN PROPERTY CUSTODIAN

APPARATUS FOR MANUFACTURING PHONOGRAPHIC DISCS

Albert B. St. Hilaire, Paris, France; vested in the Alien Property Custodian

Application filed June 29, 1940

This invention relates to the manufacture of phonographic discs, and has for its object certain improvements in the apparatus for manufacturing coated phonographic discs; which may thereafter be used for recording and reproducing sound in a conventional manner.

It has been the practice heretofore to make direct recording phonographic discs by coating blanks, such as aluminum, zinc, paper cardboard, and the like, in the following ways: the discs, containing holes in their centers, are mounted on a rod with spacers between adjacent blanks. While the rod is horizontally disposed, the lower half of the discs is submerged in a body of coating composition. The rod is revolved, thereby coating the discs on both sides. The discs are then withdrawn from the body of coating composition, and the rotation is continued until the coating on the discs hardens to a sufficient extent; after which they are dried. According to another method, the blank discs are sprayed with the coating composition. In accordance with a third method, the coating composition is dropped onto the discs, near their centers, while they are rotated. This rotation tends to spread the coating composition laterally across the face of the discs. These three customary methods of coating discs leave much to be desired, because not one of the methods assures an even and smooth coating of uniform thickness; with the result that difficulties are encountered, not only in the recordation of sound, but in its reproduction.

Thus, an uneven thickness of coating on the discs causes the cutting means employed in the recordation of sound to jump up and down when passing over uneven ridges or swirl marks, which in turn causes deep and shallow grooves that impair sound reproduction qualities. An uneven thickness of coating also results in uneven drying, and thus produces a non-homogeneous surface. Discs with an uneven coating usually have an undesirable scratch noise. From the viewpoint of economy, an uneven coating is objectionable because the thinnest portion of the coating must be sufficiently thick to record in, and the excess coating is therefore wasted. Uneven coatings also obscure defects in the discs, making inspection for serious imperfections difficult or wellnigh impossible.

As a result of my investigations, I have discovered improvements in the method of manufacturing phonographic discs that largely overcome the difficulties enumerated. In accordance with the practice of the invention, each blank disc may be given a smooth, even coating of substantially uniform thickness, such as has not heretofore been obtained on material of the thickness required for use in recording. This is accomplished in a manner radically different from the methods heretofore employed.

In the practice of the present invention, a series of blank discs are successively placed on a practically imperforate band, the band being wider than the discs so as to provide a substantial amount of uncovered band immediately around each disc resting thereon. The band and discs are passed horizontally at a uniform and steady rate of speed under a feeding hopper containing a suitable coating composition, such as lacquer, the hopper extending laterally across the discs and at least over a portion of the uncovered band beyond both sides of each disc.

The discs are maintained at a predetermined and uniform distance from the bottom of the hopper. Coating lacquer is steadily discharged from the hopper as the discs pass thereunder. The viscosity and the amount of coating lacquer discharged from the hopper are such as to completely fill the gap between the discs and the bottom of the hopper without flowing out of the side of the hopper counter to the direction of travel of the discs, so that a coating of substantially the thickness of the gap is evenly spread across the top surface of each disc as it leaves the hopper; while the portion of the band immediately surrounding each disc is coated to a thickness substantially equal to the combined thickness of the blank disc and its coating.

The coated discs embedded on the band are permited to travel a sufficient distance to clear the hopper, after which they are separated from the coated portion of the band at its discharge end, and are then suitably dried.

In addition to the method outlined, the invention also contemplates a treatment of the blank discs with a wetting agent miscible with the lacquer while in transit on the band to condition the surfaces for the coating and to inhibit the formation of bubbles with the coating as it dries.

In addition, special steps are employed to separate the coated discs from the coated band, in such a manner as to separate the two coatings along the perimeter of the discs. To this end, the band is passed downwardly at its discharge end and the forward portion of each coated disc is projected in a horizontal direction so that the coating on that part of the band is automatically and progressively sheared or severed from the coating around the forward perimeter portion of

the disc. The projecting portion of the coated disc is gripped and the disc propelled forward at a speed somewhat greater than that of the traveling band, to separate the two coatings along the perimeter of the rear portion of the coated disc.

A substantially constant supply of coating lacquer is maintained in the feed hopper which is sufficient in amount to provide enough hydraulic pressure to straighten out slight bends in the discs as they travel on the band under the hopper. This insures an even coating of substantially uniform thickness across the top of the discs as they emerge from under the hopper and then tend to assume their original slightly bent condition.

These and other features of the invention will be better understood by referring to the attached drawings, taken in conjunction with the following description, in which:

Fig. 1 is a diagrammatic front view of an apparatus illustrative of a practice of the invention;

Fig. 2 is a sectional elevation;

Fig. 3 is an enlarged sectional elevation of the coating machine shown in Figs. 1 and 2;

Fig. 4 is a sectional detail on the line 4—4 of Fig. 5 of the top of the feed hopper of the coating machine;

Fig. 5 is a section on the line 5—5 of Fig. 3;

Fig. 6 is a partial end elevation of the coating machine shown more particularly in Fig. 3;

Fig. 7 is an enlarged sectional elevation of the disc separating means of Fig. 3, showing a coated disc about to be pulled forward;

Fig. 8 is a plan view of Fig. 7;

Fig. 9 is an enlarged end elevation in part of Figs. 7 and 8;

Fig. 10 is another enlarged sectional elevation of the disc separating means of Fig. 3, showing a coated disc after it has been pulled forward;

Fig. 11 is a plan view of Fig. 10;

Fig. 12 is an enlarged end elevation in part on the line 12—12 of Fig. 11;

Fig. 13 is a sectional detail at the bottom of the feed hopper, showing how objectionable air may be entrapped while a disc is being coated;

Fig. 14 is a sectional detail similar to Fig. 13, but showing how coating material may flow forward of the feed hopper and impair the coating on a disc; and

Fig. 15 is a sectional detail similar to Figs. 13 and 14, but showing the proper manner of spreading the coating material from the feed hopper onto the discs.

The apparatus shown comprises a pair of phonographic disc coating machines 10 and 11 disposd at opposite sides of the charging end of a drying tunnel 12. Referring first to the construction of the coating machine, see Fig. 1, it will be seen that it comprises a frame 13 in which a roll of band paper 14 is appropriately supported. A band 15 extends upwardly from the roll, around a pair of round tension bars 16 and 17, thence horizontally across the top of a table 18 to the other end of the frame, around a pair of appropriately supported rollers 19 and 20; and then laterally under the table and across a scraper blade 21, between a pair of driving rollers 22 and 23 to a take-up roll 24.

Next, referring to Fig. 2, the apparatus includes a motor 25, a pulley 26, a belt 27, a pulley 28 and a variable speed mechanism 29 with a lever 30 for regulating the speed of the mechanism. A pulley 31 connects the variable speed mechanism with a belt 32 and another pulley 33 mounted on a shaft 34; to which a worm 35 is attached that meshes with a drive gear 36 mounted on one end of a shaft 37. The other end of the shaft is provided with a pair of pulleys 38 and 39. A belt 40 connects the first with an additional pulley 41 (see Fig. 3) attached to a shaft 42, on which the driving roller 22 is mounted. Driving rollers 22 and 23 are appropriately geared to form a positive drive through roller 23; these two rollers, when in gear, are adapted to pull the band 15 from the roll 14, across the table top 18 and the scraper blade 21.

A pulley 43 is mounted on the shaft 42 and is fitted with a driving belt 44 connecting with a pulley 45 attached to a shaft 46 which drives the band take-up roll 24. Provision is made for taking care of the slippage that occurs in the operation of belt 44 around pulley 45, because of the varying diameter of the take-up roll 24 as the band 15 unwinds from the fresh roll of paper 14. This consists of a lever 47 pivoted at 48 to a cross member 49 on the frame 13. One end of the lever is provided with a roller 50 adapted to place the lower portion of the belt 44 under tension as a weight 51 attached to the other end of the lever forces that end of the lever downwardly.

In order to stop the travel of the paper band 15 in case of emergency, or for any other reason the apparatus shown is provided with a bifurcated lever 52, extending under shaft 55 on which the upper roller 23 is mounted, and pivoted at point 53 to a plate 54 attached to the cross member 48. The upper end of the lever rests on a crank arm 56 pivoted at point 57 to a top cross-frame member 58. A handle 59 is attached to the crank arm. By moving the crank approximately 180°, the lower portion of the lever is lifted, and this in turn raises the driving roll 23 against a compression spring 68, thereby disengaging driving rolls 23 and 22. When this occurs, movement of the paper band 15 ceases, because the slippage of belt 44 is so great as not to rotate the take-up roll 24.

Tension bar 16 is permanently affixed at both ends to the frame, whereas tension bar 17 is fixed at one end and is adjustable with respect to the table 18 at the other end by means of an adjusting screw 61. Roller 19 is permanently affixed to the frame at the other end of the table 18, whereas roller 20 is self-centering so that the paper band is centered as it leaves the roller 19 and is taken up on the roll 24. For this purpose roller 20 is mounted in a U-shaped frame 62, at the center of which an upright stud 63 is attached. The stud is in turn mounted in a bearing 64 suitably attached to the cross member 65 of the frame.

The feeding means, see Figs. 3 and 5, for the coating liquid comprises a container 66 appropriately supported on a pair of uprights 67 suitably attached to the cross members 49 and 56 of the frame. The container is provided with lugs 68 adapted to fit onto the top of brackets 69 attached to the uprights. The discharge end of the container is provided with a spout 70 projecting through an opening 71 in a feed hopper 72. The rear of the hopper is provided with a cross plate 73 having an upper and a lower pair of lugs 74 and 75 at its sides through which a pair of rods 76 extend, the lower ends of the rods being mounted in and supported by the frame members 58. Each rod 76 is provided with a compression spring 77 mounted between the table 18 and the lower lugs 75. The upper ends of

the rods are provided with micrometric screws 78, so that the bottom of the hopper may be accurately spaced above the table 18.

Before mounting the container over the feed hopper, the opening of the spout 70 is covered with a closure 79 suitably attached to a collar 80 with a set screw 81 by means of a pair of rods 82 having extension portions 83 beyond the collar, the upper end of each being provided with a head to retain a compression spring 84 between it and the collar. After the spout 70 is pushed into the top of the feed hopper, the set screw 81 is loosened, and the collar 80 drops onto the top 85 of the feed hopper thereby closing the opening 71. The set screw is then tightened. This helps to seal the feed hopper against the entrance of dust and air; and helps to prevent evaporation of solvent in the coating liquid, such as lacquer 86.

In order to maintain a preferred lacquer level 87 in the feed hopper, see Fig. 4, the hopper is provided with a float 88 to which is attached a rod 89 extending through the top of the hopper; the outer end of the rod being secured to a lateral arm 90 pivoted at 91 to a bracket 92 secured to the top of the hopper. An air valve 93 is attached to the bracket, and the valve has a stem 94 attached to the lateral arm. The valve is provided with a port 95 for the entrance of air, and the lower end of the valve is connected with a tube 96, the other end of which fits into the top of the container 66. As the lacquer leaves the container 66 and passes into the feed hopper, a vacuum is set up in the upper portion of the container. In order to insure a free flow of lacquer from the container, it is important that this vacuum be broken at intervals. The instant construction permits the entrance of air into the top of the container when the lacquer is lowered to a certain level 87 within the feed hopper. When the float 68 reaches that level, the stem 94 opens port 95 and outside air is promptly drawn through tube 96 into the top of the container. The flow of lacquer to the feed hopper is resumed as the float rises and closes the port of the valve against further entrance of air. This action is intermittent until the container 66 is emptied.

Referring to Figs. 13, 14 and 15, the construction of the bottom of the feed hopper is shown in greater detail. The discharge opening is rectangular in cross section. In addition to vertical end walls the hopper has a front wall 97 substantially vertical to the table 10. The rear wall 98 slopes so as to converge toward the bottom of the hopper; and its lower edge portion is shaped to form a doctor blade 99 as shown. For this purpose, the edge slopes upwardly into the interior of the hopper, in such a manner as to form an acute angle with the table 18.

Referring particularly to Figs. 3, 7 and 10, the apparatus shown includes a cleaning and wiping mechanism comprising a roller 100 and one or more stationary wiping members 101 suitably fitted in a pair of movable notched brackets 102 attached to opposite sides of the table 18, immediately in front of the feed hopper. As shown more particularly in Fig. 7, the brackets 102 are supported by a pair of lateral arms 102' pivoted at 102''. In order to raise the cleaners and wipers above the moving band, when desired or necessary, the apparatus shown comprises a shaft 100' appropriately supported to the frame 13. The shaft is provided with a pair of eccentric cams 100'', and a lever 100'''. A pair of plungers 101' is positioned directly above the cams, and extend vertically through a pair of sleeves 101'' attached to the frame. By turning the lever, the brackets 102, and therefore the cleaners and wipers, may be raised above and lowered to the band. The roller and the wiping members are advantageously provided with an absorbent medium, such as linen, artificial silk and the like, which do not tend to give off lint while in use.

Still referring to Figs. 3, 7 and 10, the apparatus shown includes a coated disc removing mechanism comprising a pair of eccentric cams 103 positioned at the discharge end of and at substantially the same level as the table 18, and centrally thereof. The cams are provided with a shaft 104, the ends of which are adapted to fit into a pair of supports 105 having a series of spaced notches 106, as shown, each of which is intended for a given sized cam, the size of the cam in turn depending on the size of disc to be coated. The supports are in turn attached to a cross bar 107 extending across the rear of the machine, the ends of which are provided with a pair of vertical arms 108 suitably pivoted at 109 to the table. The vertical arms carry a pair of brackets 110 protruding laterally across the rear vertical members 111 of the frame. The brackets are in turn provided with a set screw 112 which is adapted to be screwed through the bracket against the frame so as to swing the supports 105 upwardly or downwardly to act as a leveling device for cams 103.

One end of the shaft 104 is provided with a pulley 115 equipped with an endless belt 116 extending around a roller 20, and having a depending loop portion fitted with a freely suspended pulley 117 to which a weight 118 is attached. The object of this weight is to form a friction drive and permits the registering or locating of a notch 119 in each cam 103; which, as will be shown below, is useful to the operator as a visual indicator, particularly when used in conjunction with a high spot 120 at the opposite side of notch 119 in each of the cams. The perimeter portion of the main portion of each cam travels at the same speed as the band, but the high spots 120 travel about 10% faster.

A roller 121, at substantially the same level as table 18, extends somewhat beyond the cams 103, and centrally thereof. This roller is mounted on a shaft 122 to one end of which is attached a pulley 123 provided with an endless belt 124 fitting around roller 19. The belt is provided with a loop at the lower portion of which is a freely suspended pulley 126 carrying a weight 126. The function of the weight is to make the belt serve as a friction drive. The shaft 122 is mounted at or near its center on a vertically disposed support 127 having a laterally extending arm which is adjustably attached to a plate 128 by means of a pair of set screws 129 extending through a slot 131 in the lateral arm. The plate 128 in turn rests on a cross member 132, the ends of which are provided with a pair of arms 133 pivoted at 134 to the frame members 111. The ends of the cross member are provided with a pair of set screws 135 bearing against a pair of brackets 136 protruding from the frame members 111. This construction permits adjustment of the roller 121 toward or away from the table 18, as well as upwardly or downwardly—to facilitate the removal of coated discs of various sizes from the band 15. The perimeter portion of the roller travels about 5% faster than the band.

In order to moisten the roller 100 it is advan-

tageous to provide a special mechanism therefor (see Fig. 3). To this end the apparatus shown comprises a container 137 appropriately supported above the roller to uprights 67 by means of a bracket 138. A flexible tube 138 extends from the container to a position slightly above the roller, the lower end of the tube being provided with a valve 146. The tube may be moved crosswise of the roller to moisten it as desired.

The scraper blade 21 is mounted in a funnel 141. The funnel is in turn appropriately supported on the upright 67 by means of a cross bar 142. A suitable container 143 is placed under the funnel to catch coating lacquer 165 scraped from the paper band 15 by means of scraper blade 21.

Referring more particularly to Fig. 2, the drying tunnel 12 comprises an endless conveyor 144 mounted at each end around a pair of rollers 145 and 146; the conveyor being mounted within a sealed casing 147 adapted to confine the drying air and the volatilized solvents. The driving mechanism for the endless conveyor comprises a pulley 148 attached to the driving shaft 37, which is in turn provided with a belt 149 connecting with a driving pulley 150 mounted on a drive shaft 151, the far end of which is provided with a worm 152 meshing with a worm gear 153 attached to the shaft 154 of the roller 146.

The means for supplying the drying air to be passed through the tunnel comprises a filter 155, a cooler 156, a heater 157, the heater and the cooler being equipped with coils connecting with a refrigerator 158. In addition, the apparatus includes an electrical heater 159, a blower 160, and a duct 161 provided with a damper 162; the duct connecting with the casing 147. The duct is advantageously provided with a thermometer 163. In order to supply additional heat with which to dry the coated discs, particularly near the charging end of the drying tunnel, the apparatus shown comprises one or more sets 164 of incandescent lamps or other suitable radiant heating means mounted directly above the casing 147, which is advantageously made of glass, at least its top and sides, so that the heat may readily penetrate therethrough and so that the operators may visually inspect the interior of the drying tunnel as the coated discs are passed therethrough.

The drying tunnel is also provided with an exhaust system comprising a main flue 165 and an exhaust fan 168 venting to the open atmosphere. The main flue is advantageously provided with a branch flue 167 connecting with a separate compartment 166 having a curvd end 169 extending partially around roller 145 at the charging end of the tunnel. The upper portion of the casing 147 at the charging end of the tunnel is provided with a glass panel 170 through which the operator may look while placing coated discs on the endless conveyor, and which at the same time tends to confine volatilized solvents within the tunnel and to permit their aspiration through the compartment 166, and branch flue 167 to the open atmosphere or to means for recovering the volatilized solvents. Similar glass panels 171 extend from the coating machines to the charging end of the drying tunnel, so that volatilized solvents may be similarly aspirated through compartment 166.

Special supporting means are provided for receiving the coated discs as they are fed into the charging end of the drying tunnel. They comprise a flat bar 172 to which is attached a plurality of vertical supports 173, the tops of which are in turn provided with a plurality of raised contacts 174 on which the coated discs may rest. The vertical supports are relatively small in cross section, so that the discs may be supported at their center portions; which do not ordinarily contain recording grooves.

In order that the drying tunnel may continue to operate even though it is desirable to stop one or more of the coating machines in an emergency, or for any other reason, the apparatus shown makes special provision for this purpose. Movement of the band 15 may be promptly terminated by disengaging the gears of driving rollers 22 and 23, by lifting lever 52; but it is also desirable to terminate the discharge of coating lacquer from the feed hopper 72. To this end (see Figs. 3 and 5), the structure includes means for dropping the bottom of the feed hopper squarely onto the band and the top of table 18; which is sufficient to prevent escape of the coating lacquer. The means include a cross bar 175, the ends of which are attached to the uprights 67 by a pair of brackets 176. A bearing 177 is secured to the top of the cross bar, centrally thereof; and is fitted with a crank 178, to one end of which an eccentric cam 179 is attached and suspended over a bracket 180 attached to the front wall of the feed hopper. The feed hopper may be dropped onto the band and table by turning the crank and hence the raised portions of the cam onto the bracket. This movement forces the lugs 75 on the feed hopper downwardly on the compression springs 77. To raise the hopper, the crank is again turned, compression on the springs is reduced, and they push upwardly on the lugs.

The above described apparatus may be employed as follows in the practice of the invention:

Motor 25 is started, which in turn transmits movement to the endless conveyor 144 of the drying tunnel and the paper bands 15 of the coating machines. A plurality of blank discs 181, 182, 183, etc., are carefully and successively placed on the traveling band by the operator. In practice (see Figs. 7 and 8) these discs are preferably brought in point-to-point contact as they are laid on the band. The first disc moves under and is gripped by roller 100, where the top surface of the disc is subjected to the cleaning action of the solution with which the roller is moistened. In a presently preferred practice of the invention the roller is kept moist with alcohol, one of the solvents employed in the making of the coating lacquer. The alcohol is kept in container 137 and is fed onto the roller as needed. The alcohol functions to clean the top surface of the disc, particularly with respect to grease and similar impurities; and the alcohol likewise functions as a wetting agent for the disc and thereby conditions its exposed surface for receiving the coating lacquer and having it adhere thereto without the objectionable formation of bubbles, which are injurious to the coated disc. The roller likewise functions to grip the blank disc and to hold it in position on the band as the disc moves toward and under the feed hopper 72.

In order to assure a perfectly clean surface on the disc, use is also made of the wipers 101. The disc is forced under and in contact with the wipers, which function to clean the top surface of the disc of dust and other foreign substances, while at the same time wiping off surplus alcohol deposited on the disc by roller 100.

As just noted, the roller grips and holds the disc in position as it moves under the feed hopper. This gripping action continues until the

forward portion of the disc is well under the hopper and is subjected to the hydraulic pressure of the coating lacquer confined within the feed hopper. A sufficient amount of coating lacquer is maintained in the hopper to provide enough hydraulic pressure to flatten or straighten out small bends frequently found in the discs, so that they may receive an even coating of substantially uniform thickness.

By means of micrometric screws 78, the gap between the bottom of the feed hopper and the paper band is carefully calibrated to assure the desired thickness of coating on the discs. To assist in the formation of this coating of predetermined thickness, it is important that the lacquer be of homogeneous composition and that it have a suitable viscosity. The upper limit of viscosity must be such as to permit a slow flow of the lacquer to iron or smooth out small irregularities necessarily inherent in the process; while the lower limit of viscosity must be such as not to permit any appreciable flow of the lacquer out of the sides of the hopper or under the discs by capillary attraction, or counter to the direction of travel of the disc. If some of the lacquer should flow underneath the disc, it would unfit that side of the disc for coating.

As the disc passes under the hopper a sufficient amount of the lacquer is spread thereon to provide a coating 184 having a thickness substantially the depth of the gap between the top of the blank disc and the bottom of the hopper or doctor blade 89. The outside of the rear wall 88 of the hopper is maintained free of lacquer as the coated disc emerges from under the hopper, so as not to impair the evenness of coating due to creeping of lacquer up the wall It is customary for the operator, if necessary, to scrape that part of the wall clear of lacquer before a disc is passed under the hopper.

Figs. 13 and 14 illustrate wrong methods and Fig. 15 illustrates a proper method of coating the discs. Thus, in Fig. 13, the coating lacquer 86 is shown dropping onto a disc from the feed hopper in such a manner as to leave a wedge-like gap 190 which entraps air that becomes occluded in the coating as air bubbles 191. Some of these bubbles rise to the surface and form pimples or berries 192 on the surface of the coated disc, which of course impair the disc for sound recordation and reproduction purposes. This objectionable result is in large part due to a too rapid passage of the disc under the hopper, the use of lacquer too viscous for the speed of travel of the disc, or, generally to insufficient wetting of the disc surface with alcohol.

Fig. 14 on the other hand, illustrates what happens when the surface of the disc is excessively wetted with alcohol, or when the lacquer is too thin, or when the disc does not pass under the feed hopper rapidly enough. The lacquer 86 hits the wetted surface of the disc, spreads instantaneously and runs forward of the feed hopper, extending forward of the front wall 97 to form an overflow mass 193 of lacquer, which builds up on the outside of the wall; and this tends to produce stringiness or unevenness of the coating on the disc. It is for this reason that the operator keeps the outside surface of the wall scraped clean of lacquer, as shown in Fig. 15.

Fig. 15 illustrates a proper method of coating discs. In this case, the lacquer tends to flow toward the front of the feed hopper, but only proceeds to a convenient point under the front wall 97, such as indicated by the numerals 194, 195, 196, etc. When this occurs, air is not entrapped in the lacquer on the disc, and the lacquer does not of course escape to the front of the feed hopper. This happy result is obtained when the surface of the disc is properly wetted, and where the viscosity of the lacquer and the speed of travel of the disc under the hopper are properly correlated.

As will be clear from the drawings, the band is wider than the discs and thereby provides a substantial amount of uncovered band immediately surrounding each disc resting thereon. The band and discs are passed horizontally at a uniform and steady rate of speed, under the hopper while the discs are maintained at a predetermined and uniform distance from the bottom of the hopper or doctor blade. The coating lacquer is steadily discharged from the hopper as the discs pass thereunder. As indicated above, the viscosity and the amount of lacquer discharged from the hopper and the speed of the band are such as to fill completely the gap between the discs and the bottom of the hopper, so that a coating of substantially the thickness of the gap is evenly spread across the top surface of each disc as it leaves the hopper; while the portion of the band immediately surrounding each disc is given a coating 185 having a thickness substantially equal to the combined thickness of the blank disc and its coating. As the coated disc emerges from under the hopper, the coating flows sufficiently to even out minute irregularities on the surface.

The coated disc is appropriately separated from the coated portion of the band at its discharge end. For this purpose (see Figs. 7, 8, 9, 10, 11 and 12) the band is passed downwardly over roller 19 at its discharge end while the forward portion of the coated but embedded disc continues and is projected at the discharge end in a horizontal direction, away from the downwardly moving portion of the band; so that the coating 185 on that part of the band is automatically and progressively severed or sheared from the coating 184 around the forward perimeter portion of the disc. The shearing action between the coating on the band and the coating along the perimeter of the disc starts at the foremost part of the disc, where the band first parts with the disc, and proceeds rearwardly and outwardly along both sides of the disc. This cutting movement continues until the first half of the coated disc passes over roller 19.

The shearing action is more particularly illustrated in Figs. 7, 8 and 9. The coating along the perimeter of the disc parts from the coating on the band at point 189 directly at the perimeter of the disc. It is imperative that this shearing action be sharp, uniform, and complete; and that it take place at the perimeter, and not appreciably inside or outside of the perimeter of the disc. If the shearing action should take place inside the perimeter, coating lacquer would of course be removed from the face of the disc and thus render it useless. If the shearing action should take place outside of the perimeter of the disc, strings or shreds of lacquer would dangle from the edge of the disc and tend to swing or flow around the edge and adhere to the bottom of the disc, and thus build up an incrustation of lacquer that would totally unfit that side of the disc for further use. If the under side of the disc had not previously been coated, the incrustations would make an even and uniform coating impossible; and, if it had been previously coated,

that side of the disc would of course be rendered useless.

Referring to Fig. 9, the first disc 181 in the series is shown with almost its first half portion completely separated from the band, thus leaving a clean, uncoated almost semi-circular surface area 187 on the band where that part of the disc had formerly rested. The band coating 185 continues to adhere to the band and surrounds the semi-circular clean portion 187 of the band.

When almost the first half of the coated disc passes over roller 19, and the coating on almost the first half of the disc has been sheared along its perimeter, the high spots 120 of the cams 133 strike and frictionally grip the inside of the forward portion of the disc, and, because the peripheral portions of that part of the cams travel at a greater speed than the remaining portion of the cam, the coated disc is slightly lifted at its forward portion and the whole disc is suddenly pulled forward an appropriate distance 189 from the next disc 182 in the series. When this occurs, the coating 184 on the disc is severed along its perimeter from the coating 185 on the band. This severing action extends around approximately the rear half of the disc 181.

After the initial pull on the coated disc by the high spots 120 of the cams 103, the forward portion of the coated disc reaches and is deposited on roller 121; thus providing in conjunction with the band an adequate support for the coated disc as it leaves the band. When the high spots carry the coated disc forward, a narrow open space 189' is created at both sides of the disc between its perimeter and the coating 185 on the band, where the disc and band separate above the roller 19. After the coated disc strikes roller 121, the disc is propelled forward more rapidly than the speed of the band, which action widens the gap 189—189' as the disc continues to leave the band and thus reduces the chance of coating material seeping between the disc and band.

The coated band, after the coated discs are removed, passes downwardly over rollers 19 and 20, laterally under the table across scraped blade 21, and between driving rollers 22 and 23 to take-up roll 24. Substantially all of the coating material is scraped from the band and drops through funnel 141 into hopper 143; from which it is removed and re-used to coat discs.

The operator should exercise care in removing the coated discs from the top of roller 121 and cams 183 so as not to impair their freshly coated surfaces. This may be done by lifting each coated disc from its underside and gently depositing it onto the raised contacts 174 at the top of one of the vertical supports 173 on the flat bar 172. A supply of these bars is kept at hand, and they are placed on the endless conveyor 144 one by one, as needed.

Referring to Fig. 1, the bar 172 is shown as supporting three coated discs, for example, 181, 182 and 183, on the endless conveyor 144 in the drying tunnel 12. If both coating machines 10 and 11 are simultaneously operated, the coated discs from each are transferred in this manner for drying. One or the other coating machine may be used alone in conjunction with the drying tunnel. Whether one or two coating machines are used, the speed of the coating machine or machines and the drying tunnel are synchronized so that the drying tunnel may take care of the coated discs as rapidly as they are transferred.

As pointed out above, the coated discs are preferably dried with properly conditioned air. To this end, the refrigerator 158 and blower 160 are set in operation. Air is drawn through the filter 155 to remove dust and other foreign substances, after which the filtered air is passed through the cooling coils 156 to remove moisture therefrom; and the de-humidified air is then heated by means of coils 157. If additional heat is necessary, the heated air is passed through an auxiliary heater 159. The resulting filtered, de-humidified and heated air is drawn through duct 161 and forced into the interior of the drying tunnel; and moves as a stream countercurrently to the direction of travel of the endless conveyor 144. As is sometimes desirable, the moving air may be re-heated in transit at or near the charging end of the endless conveyor. In the construction shown, such additional heat is supplied by one or more sets of incandescent lights 164.

As the stream of filtered, de-humidified and heated air passes over and under the coated discs, solvents are volatilized from the coating; and the residue remaining on the discs tends gradually to harden. By the time the drying air has reached the charging end of the drying tunnel, it abstracts a very substantial amount of the volatile solvents from the coating, and the air-solvents mixture is drawn up the flue 185 by means of the exhaust fan 186, and vented to the open atmosphere; or treated for the recovery of the solvents.

Solvents that are volatilized at the very beginning of the charging end of the drying tunnel, under glass panel 170, including solvents volatilized under the glass panels 171, under which the operator passes the coated discs from the coating machines to the drying tunnel, are aspirated through the compartment 168 and branch conduit 167 into the main flue 165 by means of the exhaust fan 166.

By the time the coated discs have traveled from the charging to the discharging end of the drying tunnel, the coating thereon is fairly well set and hardened; at least to the point at which the coated discs may be more readily handled without fear of impairing the evenness of their coating. In a present practice, the coated discs are removed from the discharging end of the drying tunnel and placed in racks (not shown) to keep the coated discs out of contact with one another; and the loaded racks are then placed in a drying chamber (not shown) where they are permitted to stand until sufficiently dried out. If the discs have been coated only on one side, they are then returned to the coating machine to have their other side coated, in the same manner as above described; after which they are subjected to a similar drying operation in the drying tunnel.

This application is a continuation-in-part of my copending application Serial No. 288,916, filed August 8, 1939.

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