United States Patent

[11] 3,537,425

[72] Inventors **Charles W. David**
Marina Del Rey, and
Eugene A. Munson, Torrance, California

[21] Appl. No. **579,392**
[22] Filed **Sept. 14, 1966**
[45] Patented **Nov. 3, 1970**
[73] Assignee **by mesne assignments, to Disc Pack Corporation, Hawthorne, California a corporation of California**

---

[54] **APPARATUS FOR COATING MEMORY DISCS WITH OXIDE OR LIKE FILM**
3 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **118/301,** 118/321, 118/326
[51] **Int. Cl.** **B05c 5/00**
[50] **Field of Search** ..... 118/321, 301, 326, 500, 504 (Hood Digest); 134/(Inquired)

[56] **References Cited**

UNITED STATES PATENTS

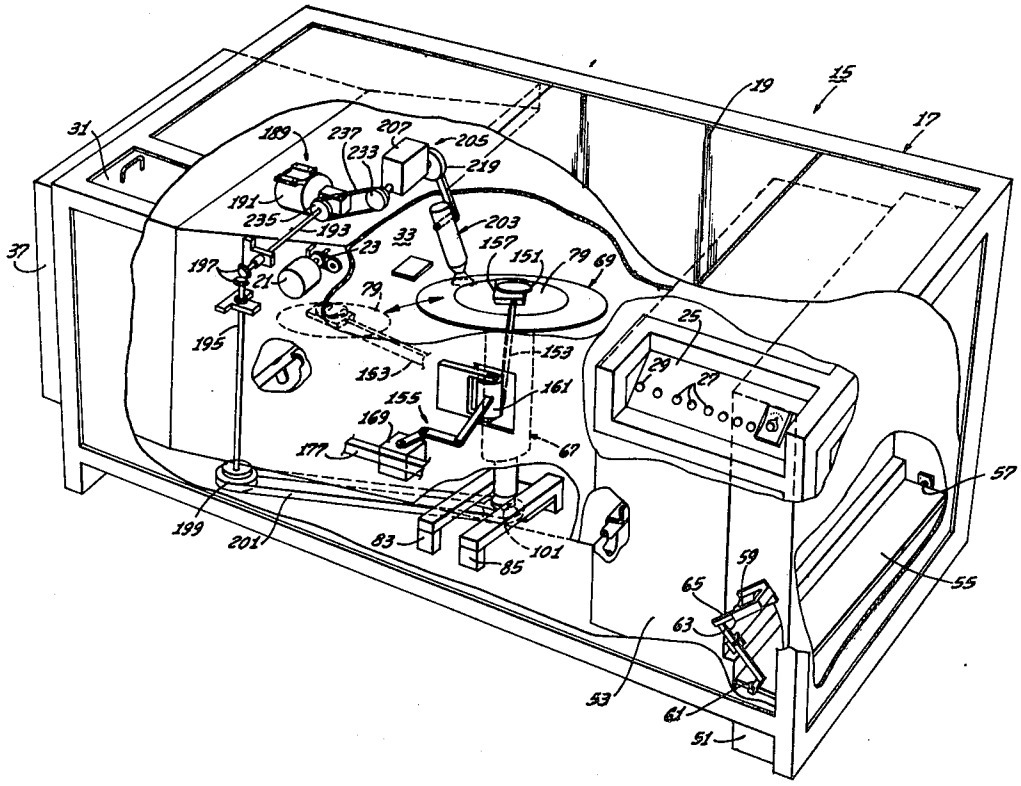
1,201,448	10/1916	Edison	118/321
1,859,797	5/1932	Ready	118/(Hood Digest)UX
2,217,345	10/1940	McGraw	118/(Hood Digest)UX
2,694,466	11/1954	Bingman	118/326X
2,883,960	4/1959	Way et al.	118/301
2,976,838	3/1961	Rychlewski et al.	118/321
3,052,212	9/1962	MacArthur et al.	118/301X
3,276,422	10/1966	McCoy	118/321
3,390,660	7/1968	McDermott	118/321X

FOREIGN PATENTS

718,190	11/1954	Great Britain	118/321

Primary Examiner—John P. McIntosh
Attorney—Smyth, Roston and Pavitt

ABSTRACT: Apparatus for spraying discs including a rotatable disc support located within a coating chamber. Arm means are pivoted within the chamber for swinging a mask from a remote position to a position above the disc located in the support. Nozzle means are movably mounted adjacent the support for spraying portions of the disc exposed by the mask.



Patented Nov. 3, 1970 3,537,425

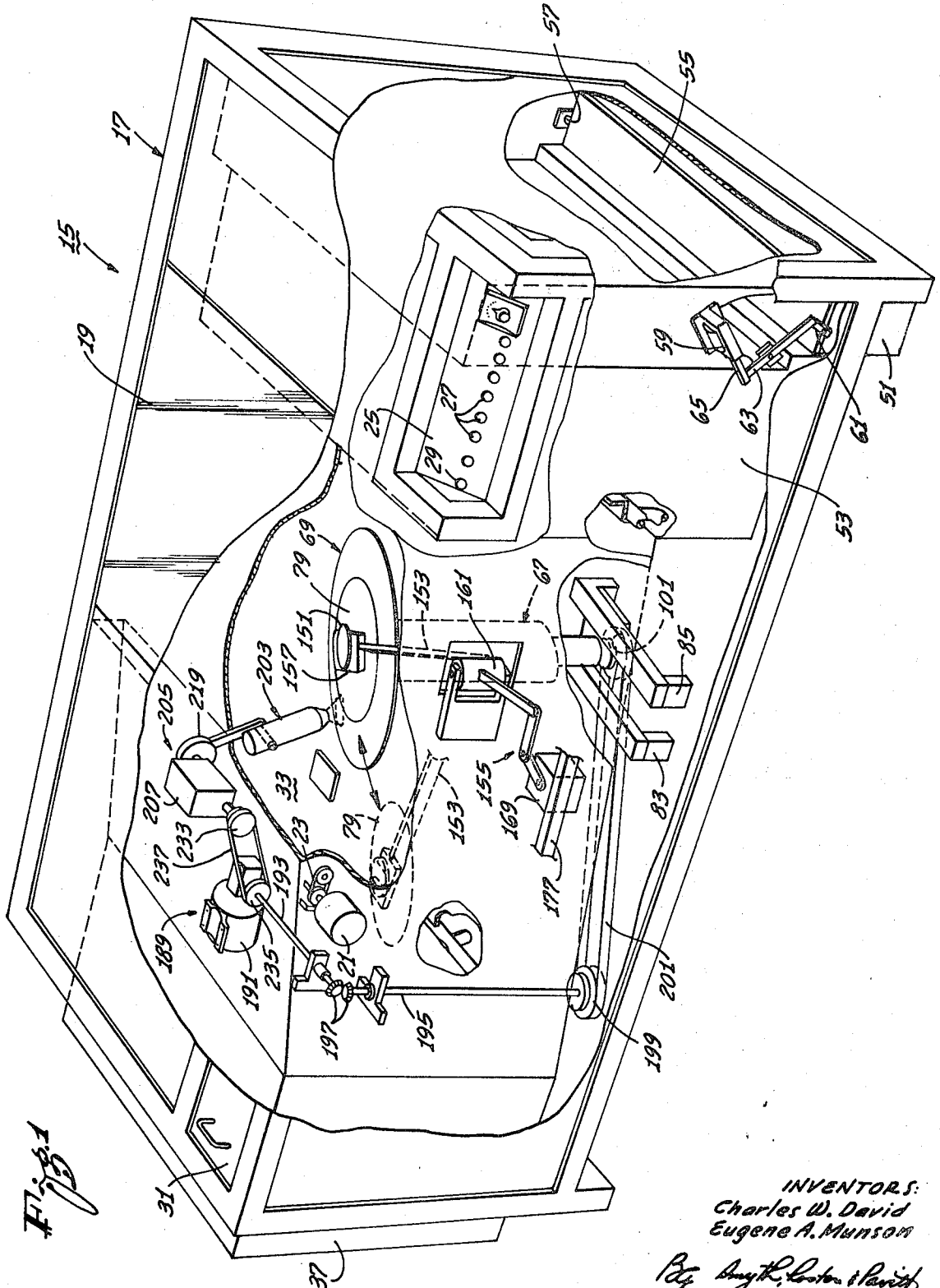


Fig. 1

INVENTORS:
Charles W. David
Eugene A. Munson
By Smyth, Roston & Pavitt
ATTORNEYS

Fig. 2

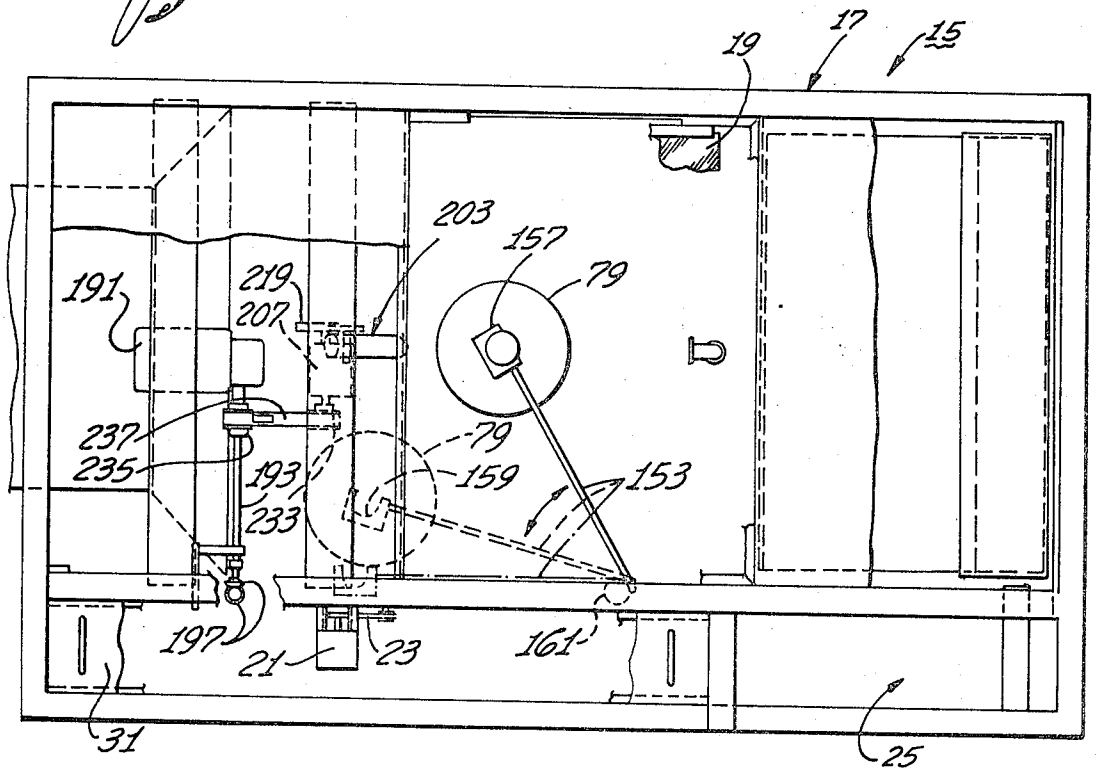
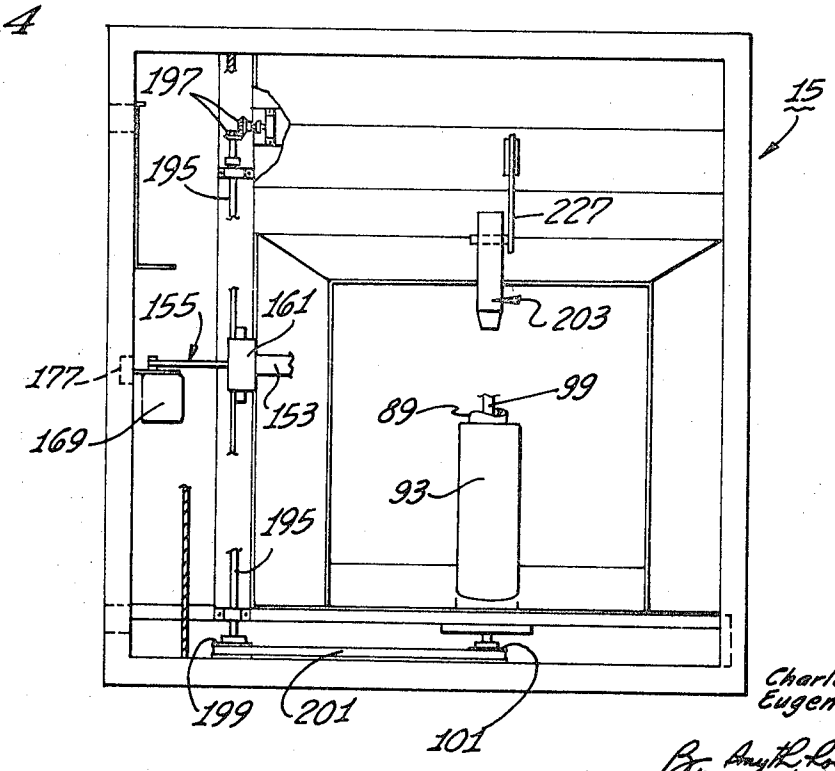


Fig. 4



INVENTORS:
Charles W. David
Eugene A. Munson

By Amyx, Loston & Parish

ATTORNEYS

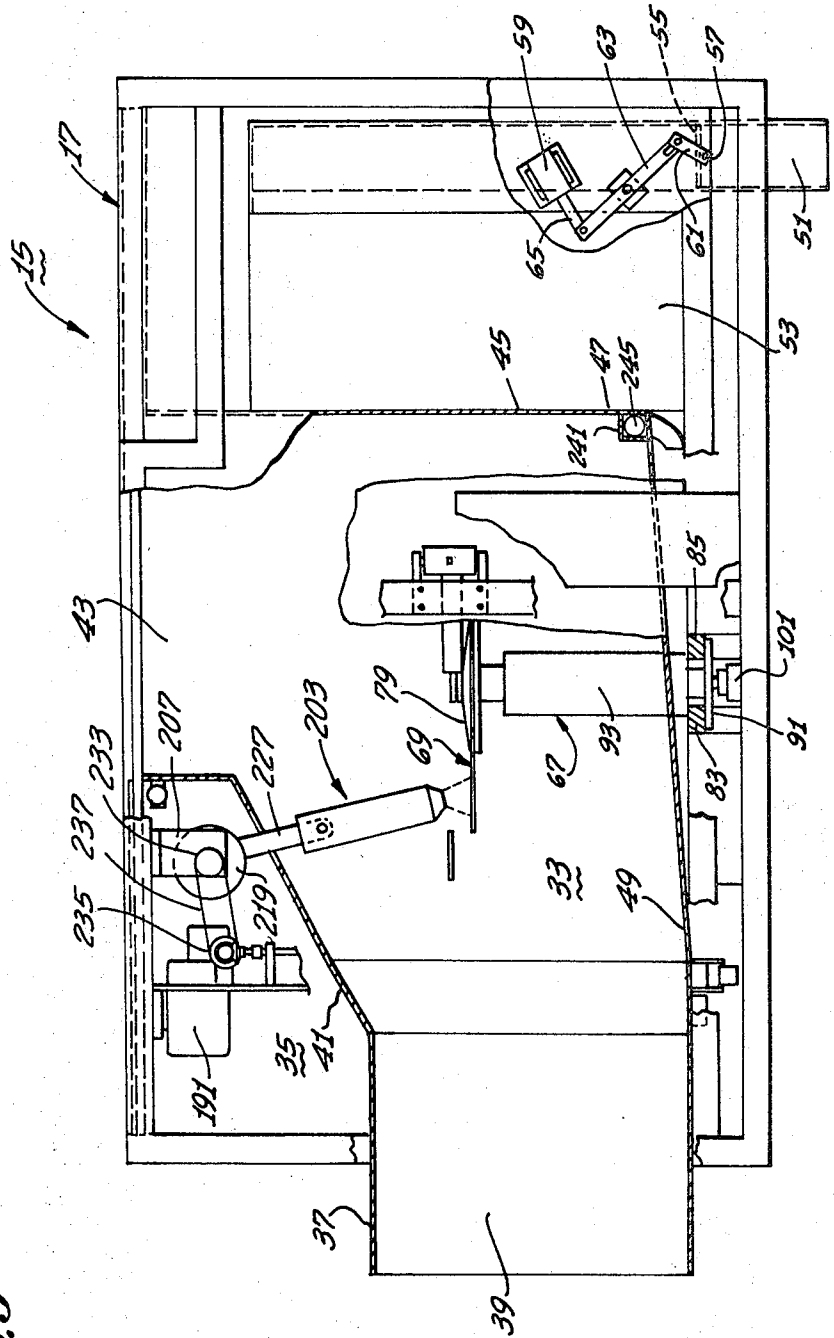


Fig. 3

INVENTORS:
Charles W. David
Eugene A. Munson

By Smyth, Roston & Pavitt
ATTORNEYS

Fig. 5

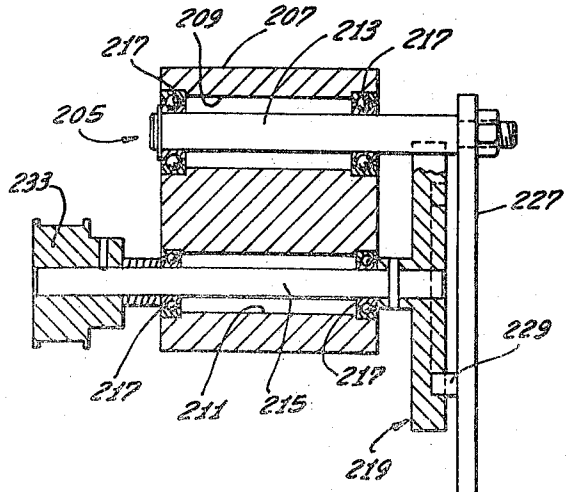
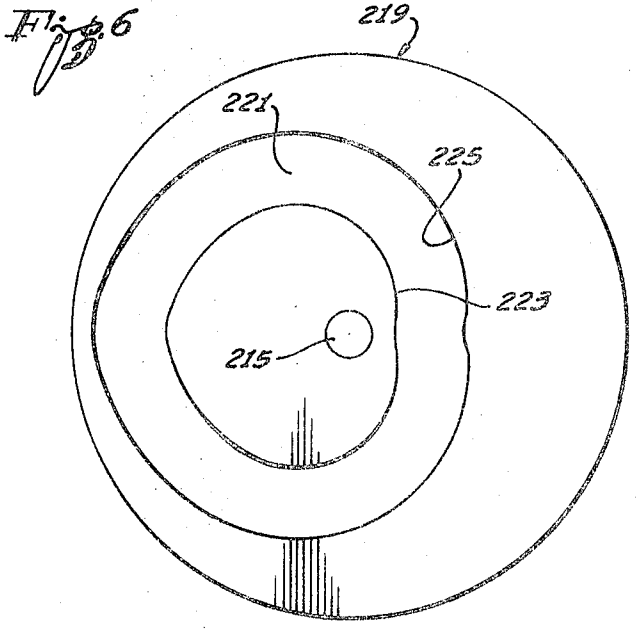
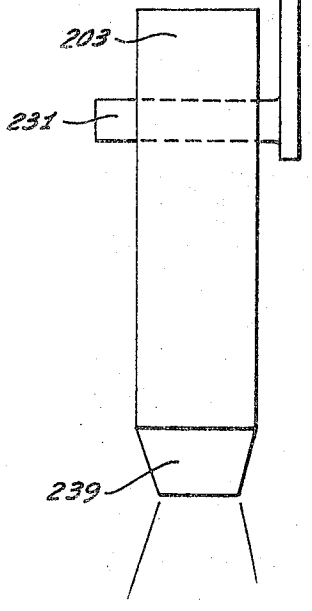


Fig. 6

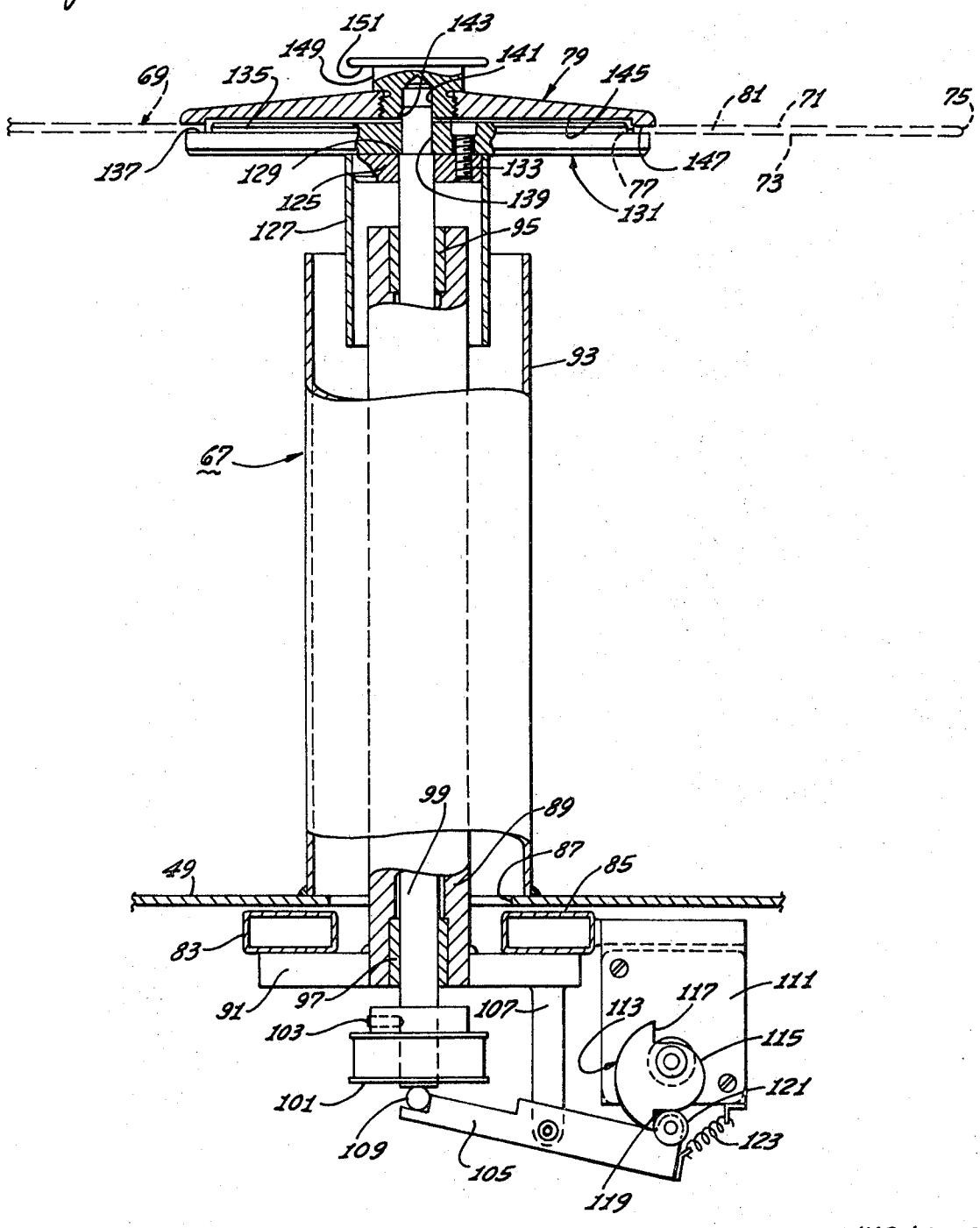




INVENTORS:
Charles W. David
Eugene A. Munson

By Smyth, Roston & Pavitt
ATTORNEYS

Fig. 7



INVENTORS:
Charles W. David
Eugene A. Munson

By Smyth, Roston & Pavitt
ATTORNEYS

Fig. 8

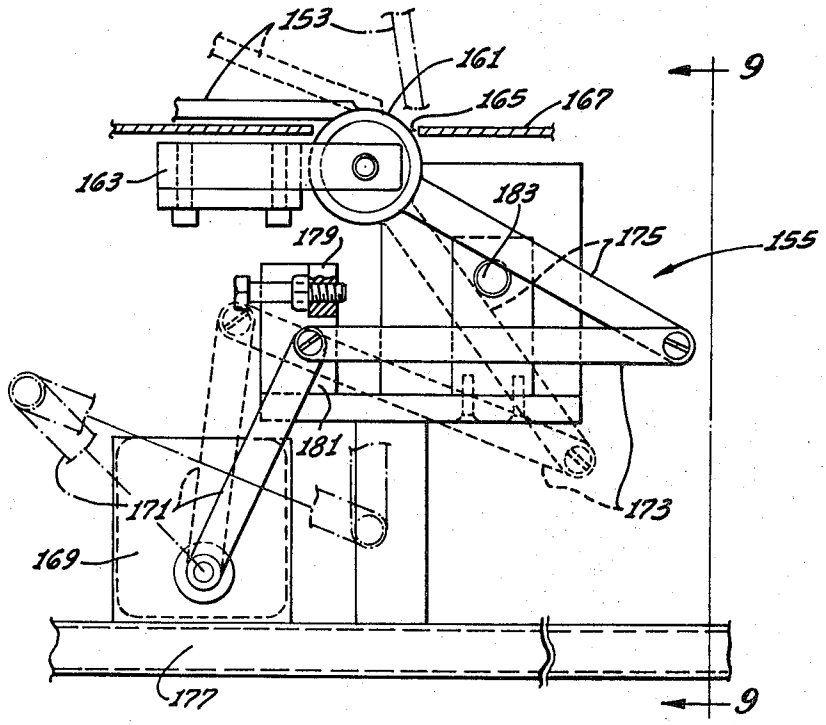
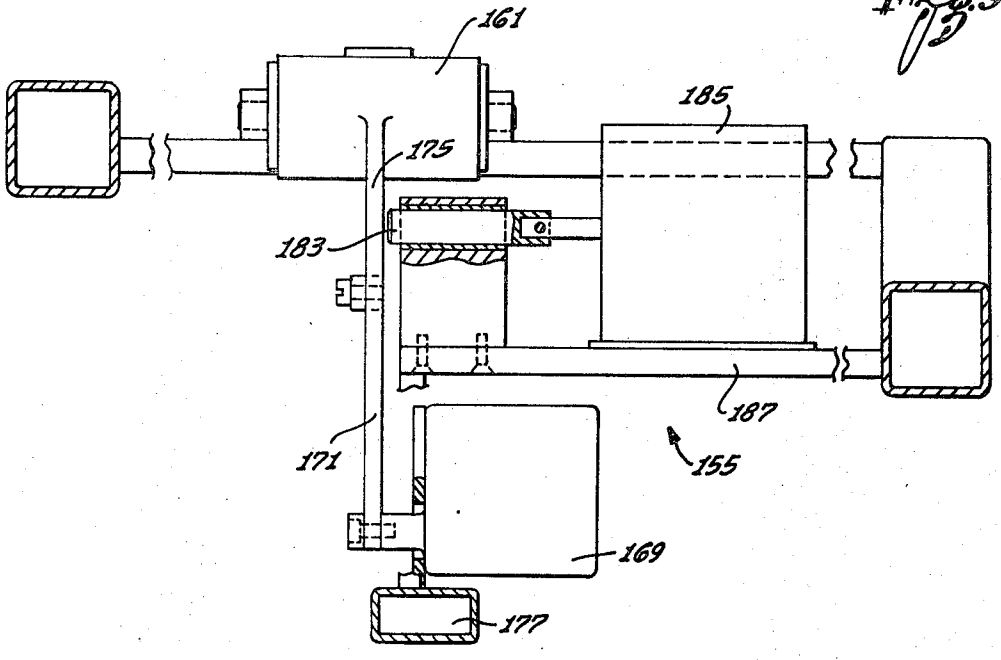


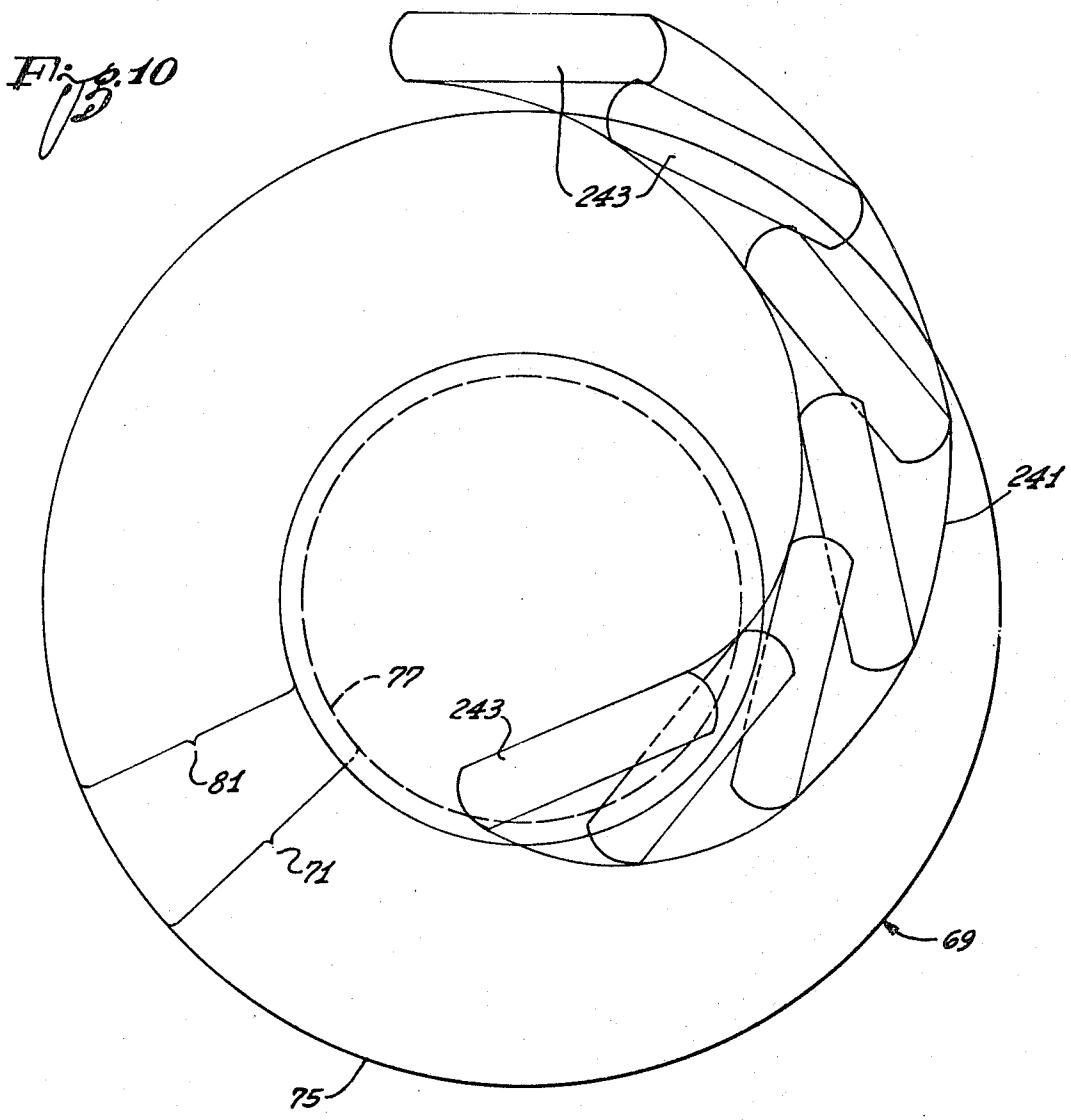
Fig. 9



INVENTORS:
Charles W. David
Eugene A. Munson

By Smyth, Roston & Pavitt
ATTORNEYS

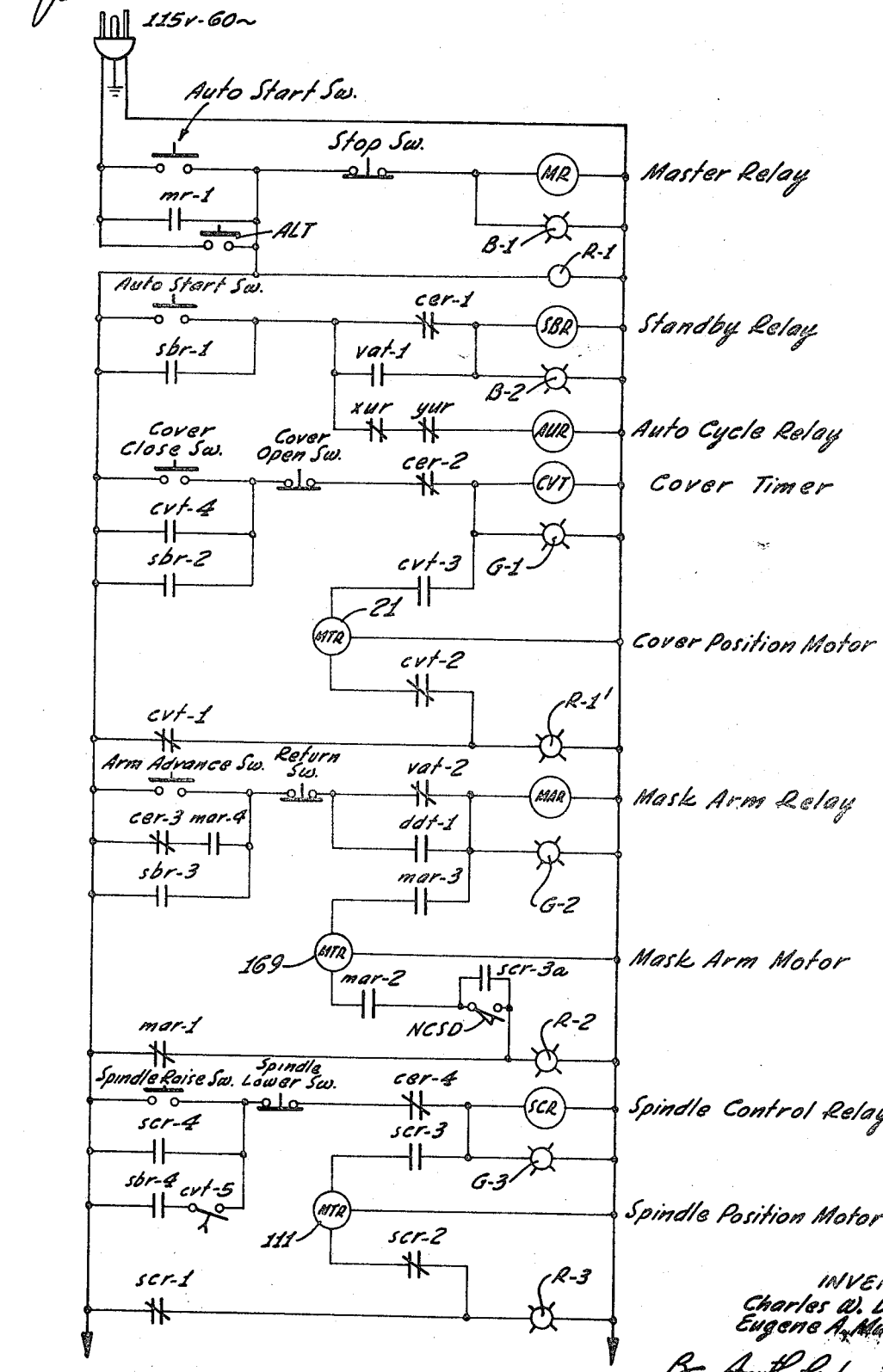
Fig. 10



INVENTORS:
Charles W. David
Eugene A. Munson

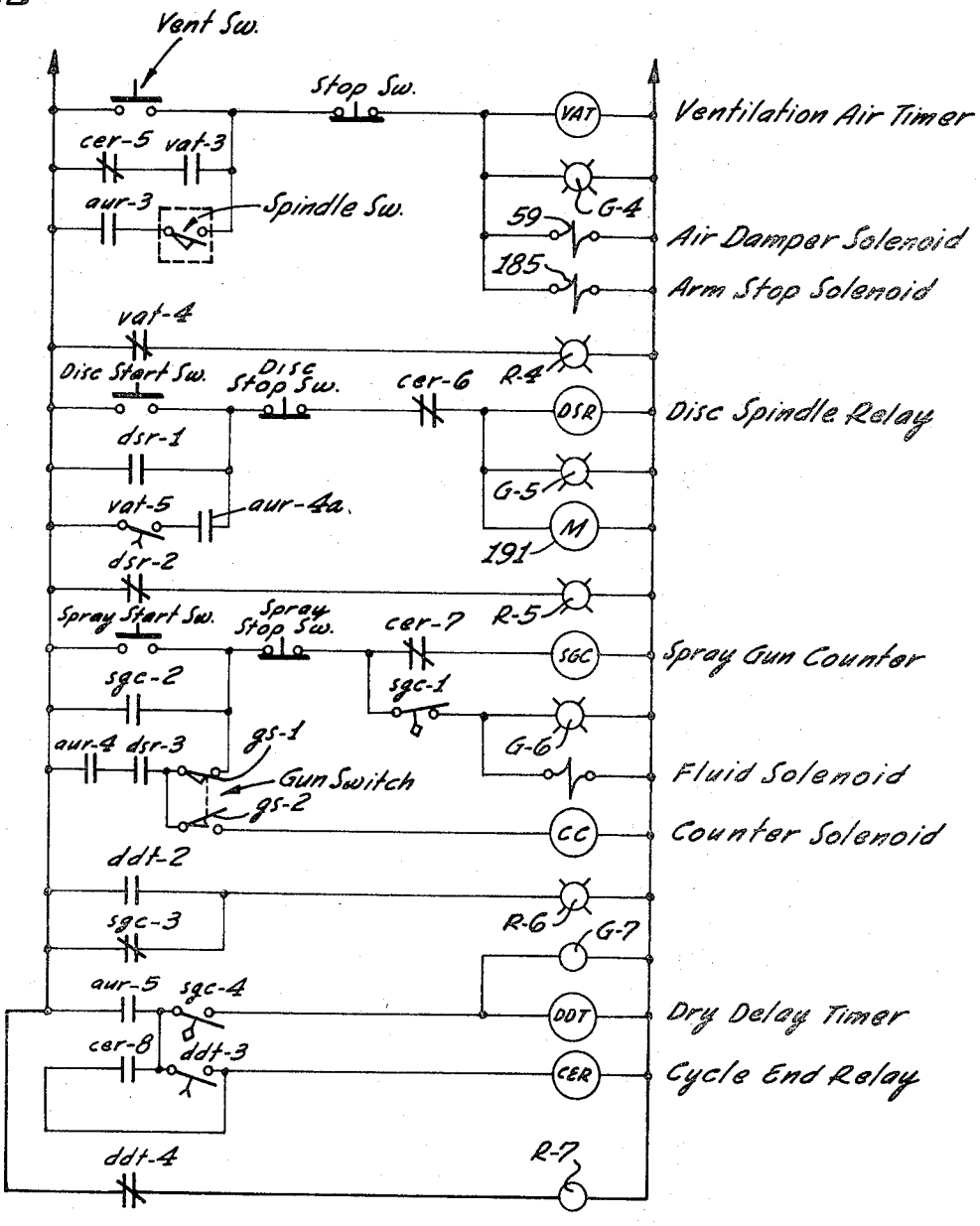
By Smyth, Roston & Pavitt
ATTORNEYS

Fig. 11



INVENTORS:
Charles W. David
Eugene A. Munson
By Smyth, Roston & Pavitt
ATTORNEYS

Fig. 12



INVENTORS:
Charles W. David
Eugene A. Munson

By Smyth, Looton & Parish
ATTORNEYS

APPARATUS FOR COATING MEMORY DISCS WITH OXIDE OR LIKE FILM

As is well known, memory discs are thin annular metal members having a thin oxide coating on the faces thereof. Information is recorded on these faces by a recording head that "flies" over a laminar air film on the face of the disc. This invention relates to an apparatus and method for applying a continuous finite layer of magnetic oxide dispersion to the faces of an annular metal member to thereby convert the latter into a memory disc.

One prior art memory disc coating device includes a movable carriage to which a disc that is to be coated is secured by a mask which is manually placed over the central portion of the disc. A spray gun is secured to an arm which oscillates about a vertical axis. As the spray gun oscillates, the carriage and the disc are moved slowly thereunder to allow the spray gun to apply an oxide coating to the exposed face of the disc. As the spray gun oscillates through a constant arc and the disc that is being coated has a circular periphery, considerable overspray, *i.e.* coating material that does not adhere to the face of the disc, is produced. In an attempt to reduce the amount of overspray remaining within the coating device, this prior art machine provides for directing a high-speed stream of air therethrough to exhaust some of this overspray.

The production of overspray in a memory disc coating device is very undesirable for at least three reasons. First, the magnetic oxide coating material is extremely expensive and any of this oxide material that does not adhere to the disc is wasted, thereby increasing the cost of manufacturing. Secondly, the presence of overspray within the coating chamber causes contamination thereof. That is, the environment in which the memory disc is placed must be surgically clean and a build up of large amounts of the oxide coating material on the walls of the cleaning chamber tends to create a dust or other particular matter which might contact the faces of the memory disc and contaminate them, thereby making the disc totally unsuited for its intended purpose.

Thirdly, the coating material emitting from the gun is in the form of many small hollow bubbles. When these hollow bubbles are forced against the face of the disc by the gun, they break to release the gas which was entrained therein. If, however, these bubbles are allowed to float gently down and contact the face of the disc, it is quite likely that they will not break and the coating material will cure with the quantity of gas entrained therein. Thus, if eddies in the purging air are formed, or if for any other reason overspray is not removed and is allowed to float gently down to the face of the disc, the disc will cure with the quantities of gas therein. During the finishing operation of the disc the faces thereof are subjected to abrasive action and the upper portion of the bubbles are ground off, thereby creating a depression or void in the coating material and the disc. Such voids make recording difficult or impossible.

In an attempt to obviate this problem, this prior art device forces a large quantity of purging air therethrough to remove the vast quantities of overspray that it produces. As the purging air must be filtered and the temperature and humidity thereof controlled, this large quantity of purging air further increases the cost of manufacturing. In addition, because of the design of the interior of the coating chamber, numerous eddies are formed which hamper removal of the overspray and cause the overspray to fall on the disc and the walls of the coating chamber.

Another problem with prior art coating devices is that the coating material is applied to the face of the disc in paths which are overlapped in a manner similar to the manner in which shingles are overlapped on a roof. Thus, the paths of coating material are applied in a repeating pattern and generally do not criss-cross. This results in the face of the disc being unevenly covered with the coating material.

Still another problem with this prior art device is that it does not perform the coating function as quickly as desired. One reason for this is that the mask which is placed over the central portion of the disc must be positioned by hand. This manual operation wastes time, but the primary disadvantage of this manual handling is that it increases the possibility of contaminating the disc.

According to the present invention, a finite layer of magnetic oxide dispersion is rapidly and efficiently applied to the faces of the disc. With the present invention, the coating material is applied to the face of the disc in overlapping criss-cross paths. This produces a very even coating. Preferably, the coating material is applied in nonrepeating paths which extend both radially and circumferentially of the disc. Thus, every portion of the disc is covered by a plurality of paths of coating material, each of which extends in at least a slightly different direction and many of which are overlapping.

With the present invention the amount of overspray is held to an absolute minimum, thereby substantially reducing the possibility of contaminating the interior of the coating member. Because overspray is held to a minimum, the amount of purging air required is substantially reduced and in one instance is only one-tenth of that required by some prior art machines. The coating chamber is designed to substantially eliminate eddies in the purging air, thereby promoting efficient exhaust of the overspray. The coating machine of this invention operates rapidly and entirely automatically, except that the disc must be manually inserted into the machine and then manually removed therefrom. The automatic operation is advantageous because it is more rapid than manual or semiautomatic operation and it substantially reduces the possiblity of contaminating the disc.

The invention includes a housing having a coating chamber therein. A support member or spindle means is provided for mounting the disc for rotation within the coating chamber with at least one face of the disc exposed to define an exposed face portion. Gun means are mounted in the chamber for directing a coating material toward the exposed face portion of the disc and a motor is provided for rotating the disc about the axis thereof. The gun is moved generally radially of the disc while the disc is rotating to allow the coating material emitted therefrom to contact all of the exposed face portion of the disc to thereby apply the coating material to the exposed portion of the disc in a plurality of paths, each of which extends radially for at least the radial width of the exposed face portion and circumferentially for a predetermined number of degrees.

If the gun means or spray gun were held stationary, the pattern of coating material emitted therefrom would be somewhat elliptical. As the spray gun is moved, this elliptical pattern forms a path of coating material along the face of the disc. To evenly cover the disc with coating material, these paths should overlap and criss-cross a number of times so that the disc, in effect, is randomly and completely covered. If this is done, every part of the disc which is coated is covered by several layers, each of which is applied with the elliptical pattern of the gun at a different angle relative to such area.

According to the present invention, this is accomplished by moving the gun means out of phase with the rotation of the disc. That is, if the gun is moved inwardly and outwardly through x cycles per minute and the disc is rotated through n revolutions per minute, the quotients of n divided by x, and x divided by n, should not be whole integers. For example, the gun may be moved through 18 cycles while the disc rotates 17 times. In this instance, the circumferential extent of each of the paths would be slightly less than 180°. This means that on successive revolutions of the disc the paths of coating material will be applied thereto in nonrepeating patterns. That is, the paths of coating material applied during each revolution of the disc will be placed on the disc in varying angular positions relative thereto so that the paths are both overlapping and criss-crossed. This provides a very even coating on the disc. It is also preferred to direct the spray from the gun means generally downwardly onto a horizontal disc.

To minimize the amount of overspray, the outward radial movement of the gun is halted to prevent the gun from directing a substantial quantity of the coating material radially out-

wardly of the peripheral edge of the disc. Thus, the gun means does not move radially outwardly a sufficient distance to cause a large amount of overspray. It is also desirable to terminate the inward radial movement of the gun so that each of the radial paths extends radially inward slightly farther than approximately the inner peripheral edge of the disc. This feature of the invention prevents unnecessary spraying of the mask of the coating device which overlies the central area of the disc adjacent the inner peripheral edge thereof.

It is apparent that the rotating annular disc has a lower tangential velocity near the inner peripheral edge than adjacent the outer peripheral edge. Accordingly, if no precautions were taken a larger amount of coating material would be applied to the radially disposed inner areas of the disc than the outer areas. To compensate for this, it is preferred to oscillate the gun means about an oscillatory axis so that the discharge nozzle of the gun will move away from the exposed face portion of the disc as the discharge nozzle swings radially inwardly. This causes the path of the coating material to widen and become thinner as it moves inwardly. Also the mechanism for oscillating the gun is designed to prevent the gun means from moving too slowly adjacent the inner periphery of the disc. These factors substantially compensate for the lower tangential velocity of the disc adjacent the inner portions thereof.

More particularly, it is preferred to position the oscillatory axis so that it lies in a plane which is generally perpendicular to the plane of the disc and intersects the last mentioned plane to define a line which does not intersect the disc. For example, when the discharge nozzle of the gun is directed vertically downwardly, a vertical line drawn from the axis thereof would lie from 1 to 2 inches outside of the outer peripheral edge of the disc when the disc has a 14 inches outside diameter. It is also preferred to oscillate the gun, because a very simple mechanism can be provided to accomplish this.

One simple mechanism for obtaining this function includes an applicator support arm having a cam follower which engages a rotatably mounted heart-shaped cam. The gun is mounted on the applicator support arm and the heart-shaped cam is rotatably mounted about a rotational axis which lies radially inwardly of the heart-shaped cam surface. This very simple arrangement accurately provides the desired oscillatory motion of the gun.

Purging air is supplied to the coating chamber preferably from an external source. Such purging air may be in the amount of 2000 cubic feet per minute, which is substantially less purging air than has been required by prior art disc coating devices. The flow of purging air is preferably automatically controlled by a solenoid actuated damper. As is explained more fully hereafter, the coating chamber of this invention has relatively smooth walls and a minimum number of protuberances which would cause turbulence or eddies in the stream of purging air. In particular, the bottom wall of the coating chamber is devoid of any transversely extended irregularity which would create substantial turbulence in the stream of purging air within the coating chamber.

In case any overspray should reach the bottom wall of the coating chamber, it is preferred to provide a header for directing a washing liquid across the bottom wall. Preferably, the bottom wall is inclined downwardly in the direction of the flow of purging air through the coating chamber so that the washing liquid flows therealong under the influence of gravity. Thus, by minimizing overspray, providing efficient flow of purging air and by providing a stream of washing liquid along the bottom wall of the coating chamber, the build-up of contaminants within the coating chamber progresses at a very slow rate.

The disc is mounted within the coating chamber by a support member which is preferably mounted on the bottom wall of the coating chamber. A mask is provided for covering a narrow annular strip along the inner periphery of the disc and to retain the disc against the support member. The mask can be moved relative to the support member to provide a space between the disc and the mask to thereby allow manual removal of the disc from the support member.

More particularly, the support member is secured to the bottom wall of the coating chamber for movement between an extended position in which the support member is spaced from the wall of the coating chamber and a retracted position in which the support member is nearer the wall than in the extended position. The mask is automatically movable between a first position in which the mask is out of axial alignment with the support member to allow the disc to be placed on the support member and a second position in which the mask is generally in axial alignment with the support member and spaced axially therefrom. Thus, with the mask in the second position, movement of the support member to the extended position causes the disc to be firmly clamped between the mask and the support member. This is accomplished completely automatically and very rapidly.

Arm means are provided for moving the mask betwe en the first and second positions. In the second position the mask is adjacent a side wall of the coating chamber. The arm has a third position in which it engages the side wall of the coating chamber. The arm assumes this third position automatically when the gun is operating to prevent eddies from forming in the purging air.

The operation of the coating machine is controlled electrically and is entirely automatic. The coating machine requires only 38 seconds to completely and accurately coat one face of a disc.

The invention, together with features and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying illustrative drawings in which:

FIG. 1 is a perspective view of an apparatus for coating memory discs with portions thereof broken away to expose the interior of the apparatus;

FIG. 2 is a top plan view of the coating apparatus with a portion of the top wall thereof broken away to expose portions of the interior of the apparatus;

FIG. 3 is a front elevational view partially in section of the coating apparatus;

FIG. 4 is an end elevational view of the coa ting apparatus with portions thereof broken away;

FIG. 5 is an enlarged end view partially in section of the gun for applying the coating material and the drive means therefore;

FIG. 6 is an enlarged plan view of the heart-shaped cam used to oscillate the spray gun;

FIG. 7 is a front elevational view partially in section of the spindle means utilized to mount the disc within the coating chamber;

FIG. 8 is an enlarged fragmentary plan view of the linkage which is utilized to move the mask with the several positions of such linkage being illustrated in phantom lines;

FIG. 9 is a side elevational view partially in section taken along line 9–9 of FIG. 8 and showing the linkage for moving the arm and mask with the movable abutment in the retracted position;

FIG. 10 is a diagrammatic plan view of the disc with one path of coating material applied thereto; and

FIGS. 11 and 12 are schematic wiring diagrams of a preferred form of electrical controls for the coating apparatus.

Referring to the drawings, and in particular to FIGS. 1—4 thereof, reference numeral 15 designates a coating apparatus constructed in accordance with the teachings of this invention. Generally, the coating apparatus includes a coating chamber 33 in which spindle means 67 rotatably mounts a disc 69. A gun 203 is supported above the disc 69 by mounting means 205 and directs coating material toward the disc. More particularly, the coating apparatus includes a housing 17 having a door 19 in the upper side thereof for providing access to the interior of the housing. The door 19 is preferably constructed of a transparent material, such as glass, and is movable in the plane of the upper side of the housing 17 to provide access to the interior thereof. A cover position motor 21 and a belt drive 23 (FIGS. 1 and 4) are provided to automatically power the door 19 between an open position in which access is

provided to the interior of the housing 17 and a closed position in which the door tightly seals the housing. Although various mechanisms may be employed to automatically open and close the door 19, it is preferred to utilize the rack and pinion arrangement described and claimed in common assignee's copending patent application entitled "Apparatus For and Method of Cleaning Memory Discs," Ser. No. 559,611 filed June 22, 1966, now U.S. Pat. No. 3,479,222.

A control panel 25 is disposed at an angle at the upper forward corner of the housing 17 as shown in FIG. 1. The control panel 25 has a plurality of indicator lights 27 and an automatic start button 29 thereon. The indicator lights 27 designate which portion of the automatic cycle of the coating apparatus is being performed and the automatic start button 29 is utilized to initiate automatic operation of the coating apparatus. A removable cover 31 is located at the left end of the top surface of the housing 17 adjacent the forward corner thereof (FIG. 1). Removal of the cover 31 provides access to a series of buttons (not shown) which permit manual control of the coating apparatus. The cover 31 is normally locked in position after start up.

As best seen in FIGS. 1 and 3, the housing 17 has a coating chamber 33 therein and an equipment chamber 35 lies between the upper left-hand portion of the coating chamber and the uppermost surface of the housing 17. The coating chamber 33 includes a hollow rectangular exhaust section 37 having an exhaust opening 39 therein, a planar inclined end wall 41, an upwardly directed access opening 43 which is closable by the door 19, and an inlet opening 45 formed in an end wall 47. The coating chamber 33 also has a preferably planar bottom wall 49 which is inclined downwardly as it extends from the end wall 47 to the exhaust section 37. The bottom wall 49 is preferably smooth and free of any transversely extending irregularities which might create turbulence within the coating chamber 33. The coating chamber 33 may be supported within the housing 17 by any suitable structural members which will rigidly mount the coating chamber.

Purging air can be supplied to the coating chamber 33 from an external source (not shown) by way of a generally vertical inlet duct 51, a large air filter 53, and the inlet opening 45 of the coating chamber. Air may be supplied to the inlet duct 51 from a central air conditioning system or other suitable means. Alternatively, the housing 17 could be provided with a fan which would force room air through the coating chamber 33. The stream of purging air exhausts through the exhaust opening 39. It is very important that the purging air be temperature controlled, very clean and free of particulate matter which might contaminate the disc or other equipment within the coating chamber 33. It has been found that air that is passed through a 3/10 -micron filter is satisfactory.

Means are provided for controlling the flow of purging air through the coating chamber 33. Such means, as best seen in FIGS. 1 and 3, includes a damper 55 which is secured as by welding to an elongated rod 57 that extends the full width of the duct 51. The rod 57 is suitably mounted for pivotal movement within the duct 51. The rod 57 is suitably connected to a solenoid actuator or air damper solenoid 59 by a link 61 rigidly secured to the rod and a lever 63 which is pivotally mounted adjacent its midpoint and slotted adjacent one end thereof. The solenoid actuator 59 has an actuator shaft 65 which is connected to one end of the lever 63 and is movable to rotate the rod 57 and the damper 55. It is apparent that the angular position of the damper 55 within the duct 51 will control the flow of air therethrough. In the fully open position, the damper 55 may allow, for example, approximately 2,000 cubic feet of air per minute to pass through the coating chamber 33.

FIGS. 1, 3, 4, and 7 show spindle means 67 for mounting a disc 69 for rotation within the coating chamber 33. The spindle means 67 is shown most clearly in FIG. 7. The disc 69 has an upper face 71 and a lower face 73, an outer peripheral edge 75 and an inner peripheral edge 77. As shown in FIG. 7, a mask 79 covers the opening in the annular circular disc and engages a narrow annular area thereof adjacent the inner peripheral edge 77. The portion of the upper face 71 which is exposed within the coating chamber 33 defines an exposed face portion 81 of the disc. Preferably, the spindle means 67 mounts the disc 69 for rotation about the central axis of the disc, the central axis preferably being vertical and the plane of the disc preferably being horizontal.

The housing 17 provides two spaced parallel frame members 83 and 85 beneath the bottom wall 49 of the coating chamber 33. As most clearly shown in FIG. 7, the bottom wall 49 of the coating chamber 33 has an opening 87 therein through which an elongated sleeve or sleeve member 89 projects vertically. The sleeve member 89 is suitably secured as by welding to a base plate 91 which in turn may be suitably supported as by the frame members 83 and 85.

The sleeve member 89 is surrounded by a vertically extending tubular member 93 which is secured to the bottom wall 49 of the coating chamber 33. A pair of sleeve bearings 95 and 97 are secured within the sleeve 89 and mount a shaft 99 for rotation and for vertical axial movement within the sleeve.

A pulley 101 is secured to the lower end of the shaft 99 by a set screw 103. The shaft 99 is supported vertically within the sleeve member 89 by a lever 105. The lever 105 is pivotally secured adjacent its midpoint to a flange 107 which depends from the base plate 91. The lever 105 supports a ball member 109 at one end thereof and the ball member engages the underside of the shaft 99 to vertically support the latter.

As shown in FIG. 7, the shaft 99 is supported in an extended position. The shaft 99 is allowed to move to a retracted position by a spindle position motor 111 which may be of the "-dead stall" type. As shown in FIG. 7, the spindle position motor 111 is mounted on the frame member 85 and is drivingly connected to a rotatable cam 113. The cam 113 has a camming surface 115 and a pair of stops 117 and 119. The camming surface 115 engages a roller 121 mounted on the other end of the lever 105 and such engagement is maintained by a coil spring 123 and the weight of the shaft 99 and the members supported thereby. To move the shaft 99 to the retracted position, the spindle position motor 111 rotates the cam 113 clockwise to allow the ball member 109 to lower and allow the shaft 99 to retract under its own weight. The stops 117 and 119 limit the rotational movement of the cam.

A collar 125 is secured to the shaft 99 adjacent the upper end thereof. A skirt member 127 surrounds the collar and extends downwardly therefrom intermediate the sleeve member 89 and the tubular member 93. The upper end of the shaft 99 is recessed to define a shoulder 129 which is flush with the upper surface of the collar 125. A disc support member 131 is secured to the collar 125 by a screw 133 for movement with the shaft 99. The disc supporting member 131 has a generally cylindrical raised center portion 135 and an annular peripheral support portion 137 on which the inner periphery of the disc 69 rests. The upper end portion of the shaft 99 projects through an aperture 139 in the disc supporting member 131.

It is apparent, therefore, that the disc support member 131 is movable vertically with the shaft 99 between the extended position in which it is spaced from the bottom wall 49 of the coating chamber 33 and the retracted position in which it is closer to the bottom wall than in the extended position. In the preferred form of the invention, the disc supporting member 131 is movable vertically between the extended and retracted positions. Likewise, the disc support member 131 is rotatable with the shaft 99.

The mask 79 has an axial recess 141, the lowermost portion of which includes a conical guide surface 143. The guide surface 143 guides the projecting upper end portion of the shaft 99 into the recess 141.

The mask 79 has a cylindrical recessed portion 145 of relatively large diameter which is adapted to receive the raised central portion 135 of the disc support member 131. The mask 79 has a rim portion 147 which engages the disc 69 and firmly clamps the latter against the support surface 137 of the disc support member 131.

To move the mask 79 laterally out of alignment with the disc support member 131, the mask 79 is provided with an upstanding projection 149 having an enlarged flange 151 at its upper end.

The mask 79 cooperates with the disc support member 131 as follows. With the support member 131 in the retracted position and the mask 79 is positioned out of axial alignment with the support member, the disc 69 can be manually positioned on the support member as shown in FIG. 7. The mask 79 is then automatically moved to a position in which it is axially aligned with, but axially spaced from, the disc 69, the support member 131, and the shaft 99. At this time, the spindle position motor 111 raises the support member 131 to clamp the disc 69 firmly between the mask 79 and the support member and to interlock the mask and the support member. The support member then retracts clear of the disc into the side of the chamber. This is the position of the components of the device which is shown in FIG. 7. When the coating operation has been completed, the support member 131 is automatically moved to the retracted position and the mask 79 is automatically moved radially of the disc 69 out of alignment therewith to allow manual removal of the disc.

An arm 153 and a linkage 155 (FIGS. 1, 2, 8 and 9) are provided for moving the mask 79. As best seen in FIGS. 1 and 2, the arm 153 is an elongated member having a mask retainer 157 at its outer end. The mask retainer 157 has a U-shaped recess 159 which is adapted to slidably embrace the projection 149 (FIG. 7) beneath the flange 151. Thus, the mask 79 can be supported on the arm 53 by the flange 151 which rests on the mask retainer 157.

As shown in FIGS. 1, 2, 8 and 9, the arm 153 is mounted for pivotal movement about a vertical pivotal axis by a hollow vertical stub shaft 161. As best seen in FIG. 8, the arm 153 is welded to the stub shaft 161 and the latter is mounted for rotation by a bracket assembly 163 which is suitably secured to a portion of the housing 17. The shaft 161 and the arm 153 project through an opening 165 in a side wall 167 of the coating chamber 33.

The linkage means 155 includes a mask arm motor 169 of the "dead sta ll" type and a driving link 171 drivingly secured thereto. The linkage 155 also includes an intermediate link 173 and a driven link 175 which is secured to the shaft 161. It is apparent that energization of the mask arm motor 169 to pivot the driving link 171 will cause swinging movement of the arm 153 as shown in FIGS. 2 and 8. The motor 169 is preferably mounted on a frame member 177 of the housing 17.

The arm 153 is movable between a retracted position in which it engages the side wall 167 of the coating chamber 33, an intermediate position, and an extended position in which it holds the mask 79 in axial alignment with the support member 131. Abutment means are provided to fix these three positions of the arm 153. The side wall 167 constitutes a first abutment for fixing the retracted position of the arm 153. As the motor 169 is of the "dead stall" type, it can remain energized in an attempt to pivot the arm 153 against the immovable side wall 167 without causing damage thereto. A second abutment 179 (FIG. 8) engages the intermediate link 173 to define the extended position of the arm 153. The abutment 179 may be suitably secured to an appropriate frame portion 181 of the housing 17 and project upwardly into the path of movement of the intermediate link 173.

A movable abutment 183 is engageable with the driven link 173 to define the intermediate position of the arm 153 (FIGS. 8 and 9). The movable abutment 183 is normally in an extended position so that it will engage the driven link 175 upon a predetermined amount of movement thereof. The movable abutment 183 is retractable, however, by an arm stop solenoid 185 which is secured to a suitable frame member 187 of the housing. Thus, when the solenoid 185 is energized, the movable abutment 183 is retracted from the path of movement of the driven link 175 to permit movement of the arm 153 to the extended position.

In operation, the arm 153 and the mask retainer 157 will retain the mask 79 in the intermediate position while the disc 69 is placed on the support member 131. The arm 153 then automatically moves the mask 79 to the extended position and the support member 131 is moved to its extended position to cause the disc 69 to be firmly clamped between the mask 79 and the support member. The arm 153 is then automatically pivoted to the retracted position against the wall 167. As the mask retainer 157 has the U-shaped recess 159 therein, and the mask is retained in position by the upper end portion of the shaft 99 (FIG. 7), the mask retainer slides freely from beneath the flange 151 of the mask when the support member 131 is raised or is in the extended position thereof. During this time the solenoid 185 is energized so that the movable abutment 183 does not halt movement of the arm 153 to the retracted position. The arm is held in the fully retracted position against the side wall 167 so that it will not cause eddies or turbulences in the stream of purging air. When the coating operation is complete, the arm 153 swings to the extended position, the U-shaped recess 159 engages the projection 149 of the mask 79 and the support member 131 is moved to the retracted position to allow the arm to support the mask and move the latter to the intermediate position.

Drive means 189 is provided for rotating the disc 69. The drive means 189 includes an electric motor 191 (FIGS. 1—3) mounted in the equipment c hamber 35, a drive shaft 193, and a driven shaft 195 drivingly interconnected by gears 197. A pulley 199 is secured to the lower end of the driven shaft 195 (FIGS. 1 and 4) and a belt 201 drivingly interconnects the pulley 199 with the pulley 101 which is secured to the shaft 99.

Gun means 203 are provided for directing a stream of coated material toward the exposed face portion 81 of the disc. The coating material applied by the gun means 203 may be o f any kind normally utilized in the production of memory discs such as a magnetic oxide material.

Gun mounting means 205 (FIG. 5) are provided for mounting the gun 203 for oscillatory movement in a radially extending plane. Such means includes a block 207 having a pair of parallel passageways 209 and 211 extending therethrough. A pair of shafts 213 and 215 are rotatably mounted in the passageways 209 and 211, respectively, by a plurality of bearings 217. A cam 219 is secured to the shaft 215 for rotation therewith. As shown in FIG. 6, the cam 219 has a heart-shaped groove 221 formed in the outer face thereof to define generally heart-shaped cam surfaces 223 and 225. The rotational axis of the cam 219 is preferably perpendicular to the plane of the cam and passes through the cam within the portion of the cam enclosed by the surface 223.

As shown in FIG. 3, the block 207 may be suitably secured to the housing 17 within the equipment chamber 35. An applicator support arm 227 is rigidly secured to the shaft 213 and carries a projection or can follower 229 which is received within the groove 221 and is slidable along the cam surfaces 223 and 225. The applicator support arm 227 also carries an outwardly extending gun mounting member 231 adjacent its lower end to which the gun 203 is rigidly secured. It is apparent that by rotating the cam 219 the applicator support arm 227 is caused to oscillate back and forth through a constant predetermined arc. Preferably, the limits of such arc are with the gun 203 in the vertical position and with the gun sufficiently inclined from the vertical to spray the inner periphery of the disc. With the gun vertical the central axis thereof may lie, for example, 1 to 2 inches outside the periphery of the disc. This assures that the disc will be thoroughly and evenly covered while maintaining the amount of sprayed coating material that misses the disc substantially constant for each outward stroke of a gun. Thus overspray is held to a minimum.

To impart rotational movement to the cam 219, a pulley 233 is secured to the other end of the shaft 215. As shown in FIGS. 1—3, the drive shaft 193 has a pulley 235 thereon mounted for rotation with the drive shaft. A belt 237 drivingly interconnects the pullies 235 and 233 to cause the shaft 215 and the cam 219 to rotate.

As most clearly shown in FIG. 5, the gun means 203 is suitably rigidly connected to the gun mounting member 231. Thus, the gun 203 oscillates with the applicator support arm 227. The gun 203 may be of any type that is suitable to direct or spray a stream of coating material against the disc 69. It is preferred to use a pneumatically operated spray gun.

The longitudinal axis of the shaft 213 defines an oscillatory axis about which the gun 203 oscillates. In order that the gun 203 will apply a lesser quantity of the coating material adjacent the inner peripheral edge 77 of the disc 69, the oscillatory axis is arranged so that a discharge nozzle 239 of the gun 203 will move axially away from the exposed face portion 81 of the disc as it moves radially inwardly of the disc. Preferably, the oscillatory axis lies in a plane which is generally perpendicular to the plane of the disc 69 and intersects the last mentioned plane to define a line which does not intersect the disc. That is, with the discharge nozzle 239 directed vertically downwardly, a line drawn from the central axis thereof to intersect the plane of the disc 69 would miss the disc by a small predetermined amount which may be from about 1 to 2 inches.

The oscillatory axis of the gun is also arranged to allow the gun 203 to move radially inwardly and outwardly of the disc. Thus, the oscillatory axis is preferably spaced radially of the rotational axis of the disc and lies axially thereabove. The heart-shaped groove 221 of the cam 219 is sized to limit such radial movement of the gun 203 to minimize the amount of the coating material that is directed radially outwardly of the outer peripheral edge 75 of the disc to thereby minimize overspray of the coating material. The heart-shaped groove 221 also limits the inward radial movement of the gun 203 so that coating material is not directed substantially inwardly of the inner peripheral edge 77 of the disc 69. Thus, the expensive coating material is not wasted through excessive overspray.

An important feature of this invention is that the oscillation of the gun 203 is out of phase with the rotation of the disc 69. This causes the coating material to be applied to the exposed face portion 81 of the disc in a plurality of overlapping criss-cross paths. FIG. 10 illustrates a path 241 of the coating material. The discharge nozzle 239 of the gun, if held stationary and directed toward a stationary target, would apply a somewhat eliptical pattern 243 of the coating material. As shown in FIG. 10, the rotational movement of the disc and the oscillatory movement of the gun 203 cause a plurality of the patterns 243 to form the path 241. The path 241 is, of course, formed as the gun 203 moves radially inwardly of the disc through one-half of a cycle. It is apparent that a similarly shaped path 241 will be formed on a different portion of the exposed face portion 81 as the gun moves radially outwardly to complete the first cycle of oscillation.

In the specific embodiment illustrated, the gun 203 will oscillate through 18 cycles while the disc 69 rotates 17 times. This causes the resulting path 241 to extend radially for a distance slightly greater than the radial width of the disc 69 and circumferentially for slightly less than 180°. It is apparent, therefore, that the paths 241 will be applied to the disc 69 at different angles with respect thereto upon each successive revolution of the disc. This assures that every portion of the exposed face portion 81 of the disc will be evenly covered with coating material. It also assures that every portion of the exposed face portion 81 will be covered by several of the paths 241 which are extending in criss-cross and overlapping relationship to each other to thereby provide a thoroughly and evenly covered surface. Stated differently, the paths 241 are applied to the exposed face portion 81 during each revolution of the disc 69 in nonrepeating patterns. It has been found that even coating results when the circumferential extent of each of the paths 241 is at least 90° and no greater than 270° and in one preferred form, the circumferential extent of the path 241 is slightly less than 180°. As the motor 191 is used to drive both the gun 203 and the disc 69, the desired relation of cycles of oscillation to revolutions of the disc is easily maintained.

Means are provided to eliminate any overspray which may fall to the bottom wall 49 of the coating chamber 33. Such means includes an apertured header 245 which extends the width of the coating chamber 33 at the intersection of the end wall 47 and the bottom wall 49 (FIG. 3). The header is covered by an elongated angle member 247, one leg of which is spaced slightly upwardly from the bottom wall 49 to allow a washing fluid distributed by the header 245 to pass therebelow and flow by gravity along the inclined bottom wall to remove any overspray that may fall thereon. Suitable outlet means may be provided for the washing fluid after it has passed along the bottom wall 49. Any suitable washing fluid supply apparatus may be provided to deliver the washing fluid to the apertured header 245.

The operation of the coating apparatus is as follows: Initially, the support member 131 is in the retracted position and the arm 153 and the mask 79 are retained in the intermediate position by the movable abutment 183. The door 19 is automatically held in the open position to provide access to the coating chamber 33 through the access opening 43.

First, the operator manually loads the disc 69 into the machine so that it rests on the support member 131 and the automatic start button 29 is depressed. The door 19 will then automatically close and the arm 153 and the mask 79 advance toward the disc 69. When the mask is positioned axially above the disc 69 and the support member 131, the support member automatically raises to clamp the disc between the support member and the mask, after which the arm automatically retracts to the fully retracted position in which it is in engagement with the side wall 167 of the coating chamber 33. Next, the damper 55 is opened to admit a stream of purging air into the coating chamber 33 and with the purging air flowing the motor 191 is energized to oscillate the gun 203 and rotate the disc 69. After a short delay period, to air wash the disc 69, appropriate controls are actuated to cause the gun 203 to begin spraying. The gun 203 applies the coating material in a plurality of paths 241 which extend radially and circumferentially along the exposed face portion 81 of the disc. When the disc 69 is sufficiently coated, the flow of coating material from the gun 203 is automatically stopped and the purging air is allowed to continue to flow through the coating chamber 33 to help dry or cure such material on the disc.

During this entire time, a washing fluid which is supplied through the apertured header 245 flows along the inclined bottom wall 249 to wash any overspray therefrom. Similarly, the radial movement of the gun 203 has been limited, as described above, to prevent the creation of any substantial amount of overspray. Likewise, with the arm 153 in the fully retracted position, it does not create eddies or turbulence in the stream of purging air during the coating cycle.

During the drying cycle, the arm 153 moves from the fully retracted position to its extended position in which the mask retainer 157 interlocks with the projection 149 and the flange 151 of the mask 79. At the end of dry time the support member 131 is retracted by the motor 111 and the arm and the mask return to the intermediate position. Next, the air stops and the cover open to allow manual removal of the disc 69 from the coating chamber 33. Except for placing and removing the disc from the support member 131, the machine functions completely automatically. The machine cycle time is only about 38 seconds for each face of the disc.

FIGS. 11 and 12 illustrate diagrammatically a preferred form of an electrical control system for controlling the coating machine. With the components of the device in the initial position as described above and after a disc has been manually placed on the support member 131, the automatic start button 29 is depressed to close the automatic start switch (FIG. 11). This causes energization of a master start relay MR and an indicator light B-1 through a stop switch. A pair of normally open contacts mr-1 provides a holding circuit for the master relay MR, and an indicator light R-1 indicates closure of the contacts mr-1. A manually operated switch ALT can also be used to initiate operation of the device.

Closing of the automatic start switch also causes energization of a standby relay SBR and an indicator light B-2 through normally closed contacts cer-1 and energization of an automatic cycle relay AUR through normally closed contacts xur and yur. More than one of the coating machines may be used. However, it may be desirable to prevent more than one of the machines from drawing on the supply of purging air at any one time. This is accomplished by the contacts xur or yur which will open if the auto cycle relay of one of the other coating machines is energized, thereby preventing energization of the relay AUR. As explained more fully hereinbelow, the relay AUR must be energized if the coating machine is to draw purging air. Energization of the standby relay SBR closes a pair of normally open contacts sbr-1 to provide a holding circuit for the standby relay and the relay AUR.

The cover position motor 21, which is of the "dead stall" type, is normally energized through two pairs of normally closed contacts cvt-1 and cvt-2. With the motor 21 so energized, the door 19 is held in the open position to provide access to the interior of the coating chamber 33. However, energization of the relay SBR causes closing of the normally open contacts sbr-2 to energize a cover timer CVT through a cover open switch and a pair of normally closed contacts cer-2. Energization of the timer CVT closes the normally open contacts cvt-3 and opens the normally closed contacts cvt-1 and cvt-2 to reverse the potential across the cover position motor 21 to cause this motor to close the door 19. Simultaneously, an indicator light G-1 is lit and another indicator light R1' is extinguished. A pair of contacts cvt-4 provide a holding circuit for the cover timer cvt. The cover close and cover open switches provide for manual operation of the cover position motor 21.

The mask arm motor 169 is initially energized through the contacts mar-1, a switch NCSD and contact mar-2. The switch NCSD is closed automatically when the spindle 67 is in its retracted position. The motor 169 can also be energized through contacts scr-3*a*. With the mask arm motor 169 so energized, the driven link 175 is forced against the upwardly projecting abutment 183 (FIG. 9) so that the arm 153 and the mask 79 are rigidly held in the intermediate position. However, energization of the standby relay SBR causes closure of a pair of normally open contracts sbr-3 to energize a mask arm relay MAR through a normally closed return switch and a pair of normally closed contacts vat-2. The mask arm relay then closes normally open contracts mar-3 and opens the normally closed contracts mar-1 and mar-2 to reverse the potential across the mask arm motor 169 to cause the latter to move the arm 153 and the mask 79 toward the extended position. Simultaneously, an indicator light G-2 is lit and an indicator light R-2 is extinguished. A holding circuit for the mask arm relay MAR is provided by normally closed contacts cer-3 and normally open contacts mar-4. An arm advance switch and the return switch provide for manual control of the mask arm motor 169.

The spindle position motor 111 is normally energized through contacts scr-1 and scr-2. When energized in this manner, the spindle position motor 111 maintains the shaft 99 and the support member 131 in the retracted position (FIG. 7). However, once the arm 153 and the mask 79 are vertically aligned with the axis of the shaft 99, the support member 131 must be moved to the extended position to clamp the disc between it and the mask. Accordingly, after a predetermined delay period, a pair of normally open contacts cvt-5 close to energize a spindle control relay SCR and an indicator light G-3 through contacts sbr-4, a normally closed spindle lower switch and normally closed contacts cer-4. This causes closure of normally open contacts scr-3 to reverse the potential across the spindle position motor 111 to cause the latter to raise the support member 131 to the extended position. Simultaneously, an indicator light R-3 is extinguished. Contacts scr-4 provide a holding circuit for the spindle control relay SCR. Contacts scr-3*a* are also closed by the relay SCR.

Referring to FIG. 12, a spindle switch automatically closes in response to the movement of the support member 131 to the extended position. As contacts aur-3 have already been closed when the support member moves to the extended position (assuming the contacts xur and yur are closed), a ventilation air timer VAT, an indicator light G-4, the air damper solenoid 59, and the arm stop solenoid 185 are all energized. Energization of the solenoid 59 moves the damper 55 to the open position to allow purging air to flow through the coating chamber 33. Energization of the solenoid 185 retracts the movable abutment 183 so that it will no longer be capable of retaining the arm 153 in the intermediate position. Energization of the ventilation air timer VAT closes the contacts vat-1 and opens the normally closed contacts VAT-2 (FIG. 11) to deenergize the mask arm relay MAR. This causes the potential across the mask arm motor 169 to again reverse to cause the latter to move the arm 153 to the fully retracted position in which it is in engagement with the side wall 167. The circuit to the motor 169 is now completed through the contacts scr-3*a*, mar-1 and mar-2. Normally closed contacts cer-5 and normally open contacts vat-3 provide a holding circuit for the ventilation air timer VAT. A vent switch and a stop switch provide for manual operation of the ventilation air timer VAT. Simultaneously, with the energization of the timer VAT, normally closed contacts vat-4 open to deenergize an indicator light R-4.

After a short delay period to air wash the disc, normally open contacts vat-5 close to energize a disc spindle relay DSR through contacts aur-4*a*, a disc stop switch and a pair of normally closed contacts cer-6. Simultaneously, an indicator light G-5 is lit and a motor 191 is started to rotate the disc and oscillate the gun 203. Contacts dsr-1 close to provide a holding circuit for the relay DSR and contacts dsr-2 open to extinguish an indicator light R-5. A disc start switch and the disc stop switch provide for manual control of the motor 191.

A gun switch having two pair of contacts gs-1 and gs-2 is operated by the oscillation of the gun 203. When the gun 203 reaches the vertical position, the contacts gs-2 open and the contacts gs-1 close momentarily until the gun passes the vertical position, at which time the contacts gs-1 open and the contacts gs-2 close. Thus, the spray begins while the gun is vertical and, therefore, when the disc spindle relay DSR is energized, a spray gun counter SGC is energized through contacts aur-4, dsr-3, gs-1, and cer-7, and a normally closed spray stop switch. Simultaneously, an indicator light G-6 and a fluid solenoid are energized through the counter contacts sgc-1 which remain closed after energization of the spray gun counter SGC. Any suitable means may be provided to cause the gun switch, spindle switch and the switch NCSD to operate as described above.

Energization of the fluid solenoid actuates a conventional control system (not shown) which causes the gun 203 to begin spraying the coating material on the disc. The contacts sgc-2 close to provide a holding circuit for the spray gun counter SGC. When the gun 203 reaches the vertical position, the contacts gs-2 open and the contacts gs-1 close to pulse a counter solenoid CC. Thus, each time the gun 203 reaches the vertical position, the counter solenoid CC is pulsed and each of these pulses is subtracted by the spray gun counter SGC. After the spray gun counter has been pulsed a predetermined number of times, the counter contacts sgc-1 open to deenergize the fluid solenoid and the gun 203 automatically stops spraying the coating material when the gun is vertical and therefore directing substantially no coating material on the disc. When the spray gun counter SGC is energized, contacts sgc-3 open to extinguish an indicator light R-6.

When the gun 203 has been oscillated a predetermined number of counts, counter contacts sgc-4 close to energize a dry delay timer DDT and an indicator light G-7 through contacts aur-5. This causes closure of the contacts ddt-1 (FIG. 11) to energize the mask arm relay MAR and reverse the potential across the mask arm motor 169. The mask arm motor therefore causes the arm 153 to move toward the mask

79 and engage the projection 149 thereof. During this time, the purging air continues to flow through the coating chamber 33 to assist the drying of the coating material on the disc and to remove the overspray from the coating chamber. Similarly, the motor 191 continues to operate. Contacts ddt-2 close to energize the indicator light R-6, and contacts ddt-4 open to extinguish indicator light R-7.

After a predetermined time delay, contacts ddt-3 close to energize a cycle and relay CER which is held in the energized condition by the closure of contacts cer-8. This causes shutdown of the coating machine as follows. First, the contacts cer-4 open to reverse the potential across the spindle position motor 111 to allow the disc and the support member 131 to move to the retracted position. The contacts cer-6 open to deenergize the disc spindle relay DSR. The contacts cer-3 open so that when the spindle approaches or reaches the retracted position, the spindle switch opens to deenergize the ventilation air timer VAT, the air damper solenoid 59, and the arm stop solenoid 185. This causes the flow of purging air to stop and the abutment 183 to move upwardly to define the intermediate position for the arm 153. The contacts cer-1 open so that when the deenergization of the ventilation air timer VAT occurs, the normally open contacts vat-1 open to deenergize the relay SBR. Opening of the co ntacts CER-2 allows the cover position 21 to open the door 19. Opening of the contacts cer-3 and sbr-3 deenergizes the mask arm relay MAR to complete a circuit through the contacts mar-1 and mar-2 and the switch NCSD. This reverses the mask arm motor 169 to cause the latter to move the arm 153 to the intermediate position in which it is in engagement with the movable abutment 183. The contacts cer-7 open to reset the spraygun counter SGC. When the door 19 opens, the disc can be removed from the coating chamber 33. Although manual control switches are provided in the circuitry of FIGS. 11 and 12, the coating machine will normally be operated automatically and the manual control will normally only be utilized during setup of the machine.

Although an exemplary embodiment of the device has been shown and described, many changes, modifications, and substitutions may be made by one having ordinary skill in the art without necessarily departing from the spirit and scope of this invention.

We claim:

1. In an apparatus for applying a coating material to a memory disc having first and second opposed faces, the combination of:

a housing defining a coating chamber therein;

support means within said housing and engageable with the second face of the disc for supporting the disc within said coating chamber with the first face of the disc exposed;

a mask engageable with the first face of the disc to clamp the disc against said support means;

arm means pivotally mounted to said housing for moving said mask between a first position in which said mask is aligned with said support means and a second position in which said mask is laterally displaced from said support means;

dead stall motor means for pivoting said arm means;

first and second abutment means engageable with said arm means for defining said first and second positions of said arm means, respectively;

means within the coating chamber for applying the coating material to the first face of the disc;

said coating chamber having a side wall, said arm means being movable toward said side wall in moving from said first position toward said second position; and

means for retracting said second abutment means to allow said arm means to move to a third position in which said arm means engages said wall.

2. In an apparatus for applying a coating material to a memory disc, the combination of:

a coating chamber having a wall;

a support member for supporting the disc within the coating chamber;

means secured to said wall for mounting said support member within said coating chamber;

a mask;

arm means secured to said coating chamber for moving said mask from a first position in which said mask is out of axial alignment with said support member to allow the disc to be placed on said support member to a second position in which said mask is generally in axial alignment with said support member and spaced axially therefrom;

means for moving said mask and said support member relative to each other to reduce the axial distance therebetween when said mask is in said second position thereof to clamp the disc between said mask and said support member;

means in said coating chamber for applying the coating material to the disc; and

recess means on one of said mask and said support member and projection means on the other of said mask and said support member, said projection means being alignable with said recess means when said mask is in said second position thereof, and conical guide surfaces on one of said projection means for guiding the projection means into said recess when said mask and said support member are moved relative to each other to reduce the axial distance therebetween.

3. A combination as defined in claim 2 wherein said means for mounting said support member includes a sleeve member rigidly secured to said wall of said coating chamber and a shaft mounted in said sleeve member for rotation and axial movement relative thereto, said shaft being secured to said support member, said means for moving said mask and said support member relative to each other including means for moving said shaft axially in said bearing, and means are provided for rotating said shaft.