

May 31, 1955

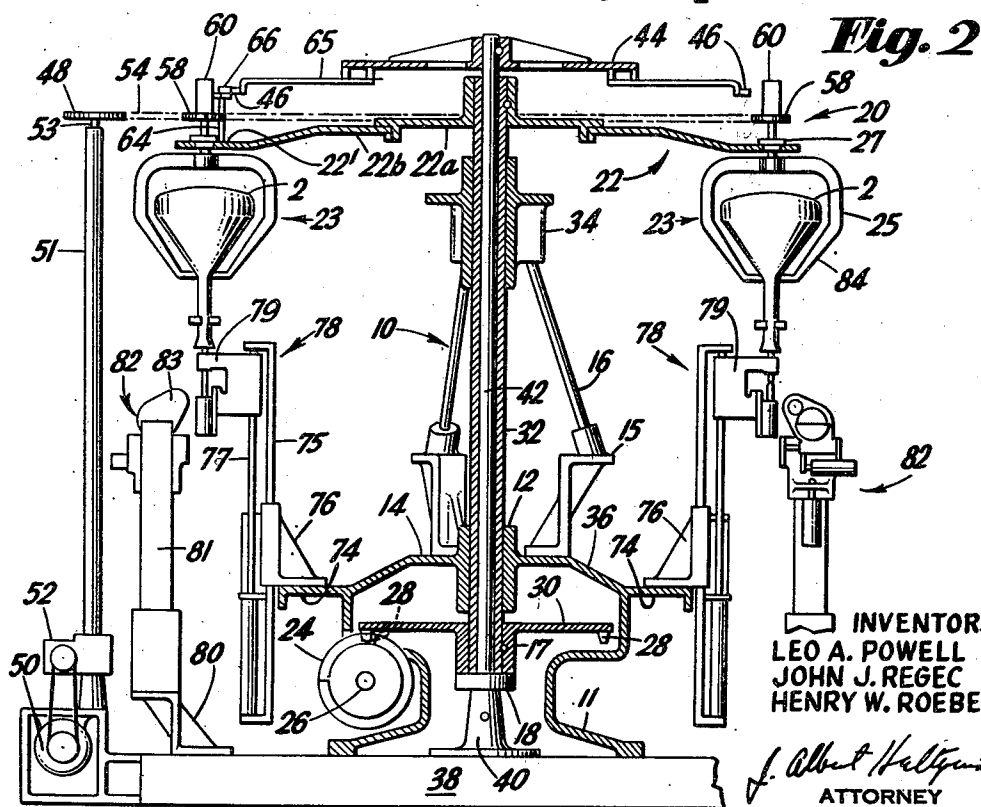
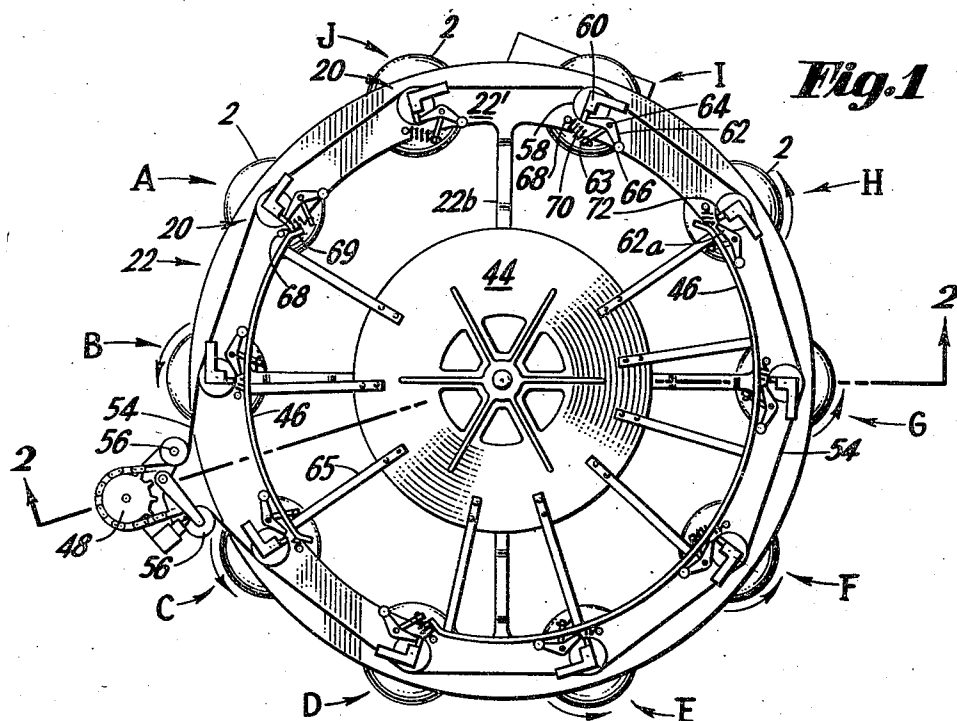
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2,709,414

COATING MACHINE FOR CATHODE RAY TUBES

Filed Sept. 18, 1951

5 Sheets-Sheet 1



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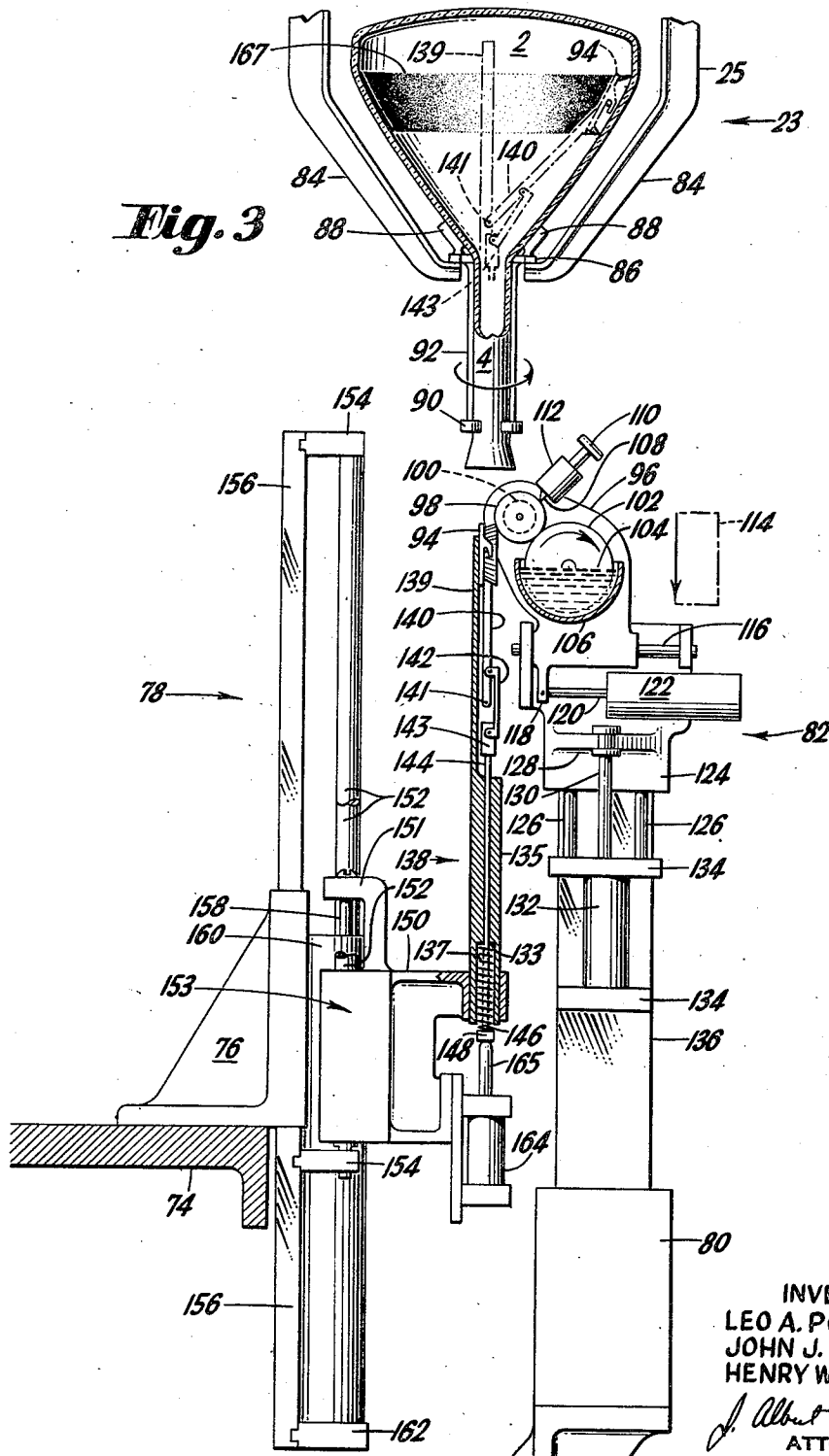
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COATING MACHINE FOR CATHODE RAY TUBES

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5 Sheets-Sheet 2



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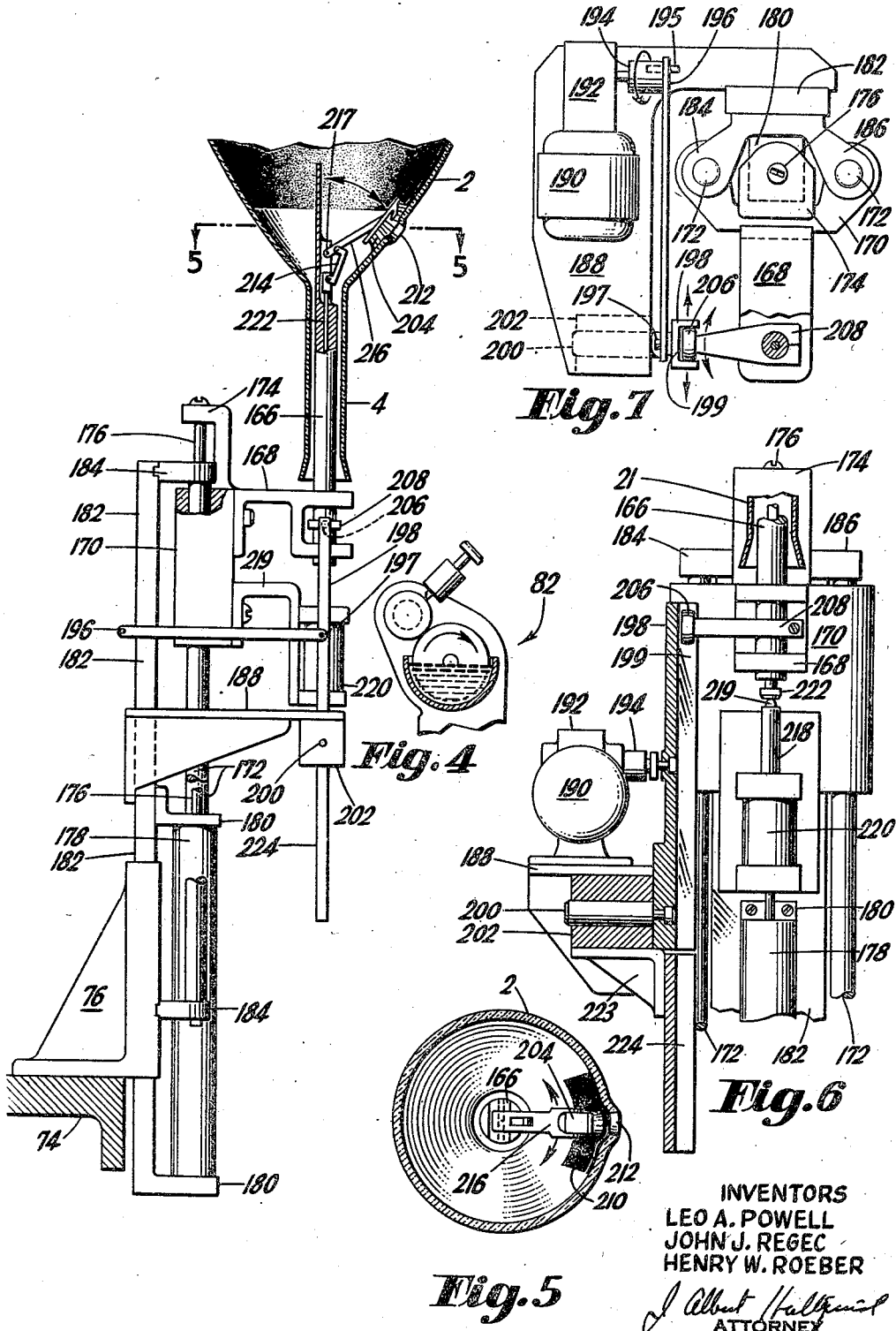
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COATING MACHINE FOR CATHODE RAY TUBES

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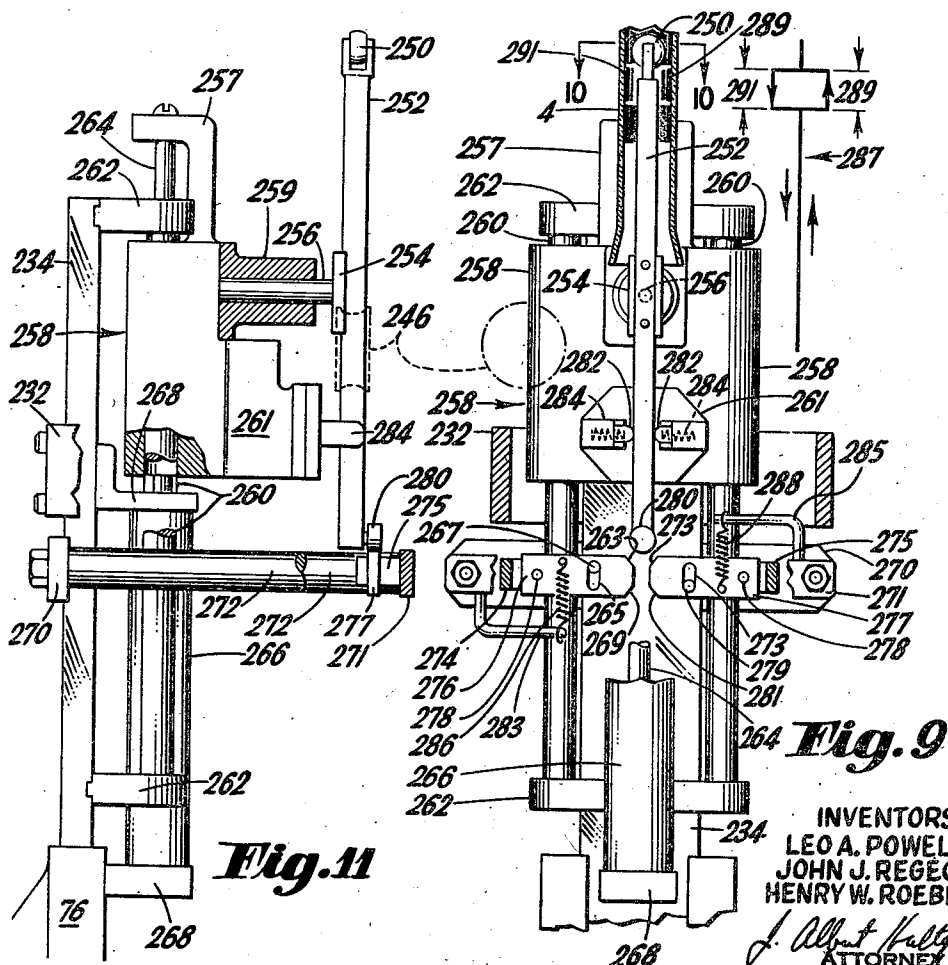
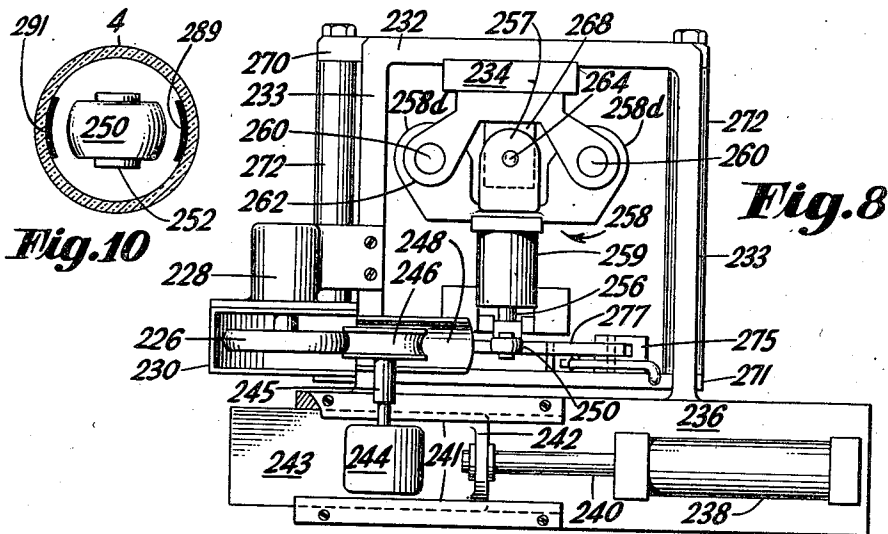
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COATING MACHINE FOR CATHODE RAY TUBES

5 Sheets-Sheet 4



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COATING MACHINE FOR CATHODE RAY TUBES

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5 Sheets-Sheet 5

Fig. 12

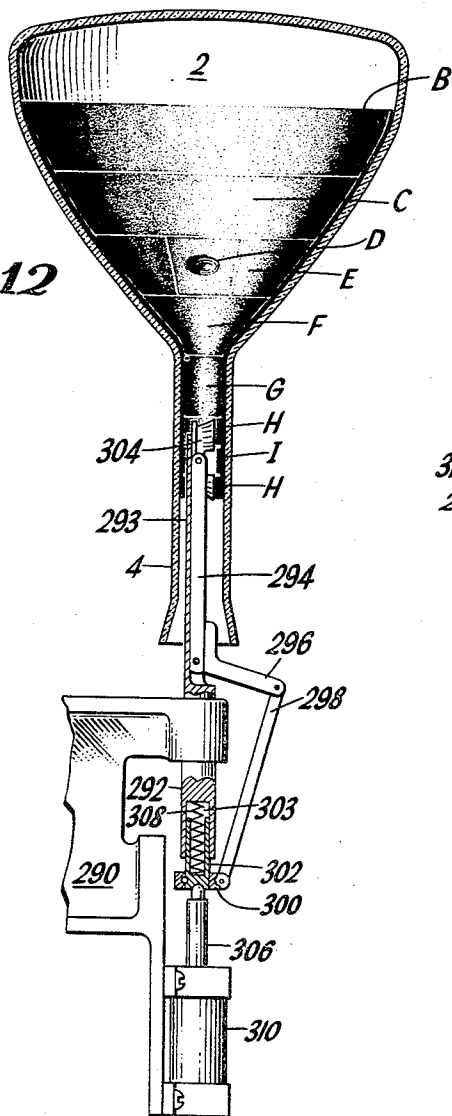
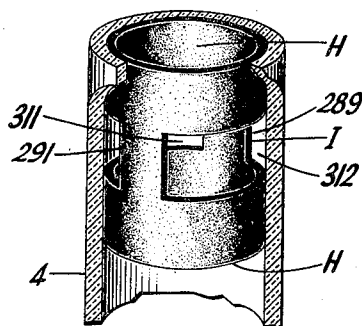


Fig. 13



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COATING MACHINE FOR CATHODE RAY TUBES

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17 Claims. (Cl. 118—215)

This invention relates to apparatus for the application of coatings to the interior surfaces of chambered articles, and more particularly to the interior surface of chambered articles, such as glass envelopes for cathode ray tubes. Such envelopes, known in the art as cathode ray tube blanks, include a substantially closed vessel portion, the interior of which is accessible through a restricted neck aperture. The apparatus finds a wide field of utility in the application of conductive coatings to the interior walls of such cathode ray tube envelopes.

A primary object of the invention resides in the provision of an automatically operable apparatus for coating the interior walls of flask-like articles.

Another object of the invention is the improvement of interior coatings of flask-like articles.

Another object is to provide apparatus which can be controlled in a manner to apply, on a production basis, substantially identical electrically conducting coatings interiorly of envelopes.

Another object is to provide a coating machine capable of accurate control and duplication of all operations.

Still another object resides in improved apparatus for application of a precise and uniform coating of an aqueous suspension of graphite such as "aquadag" to the interior walls of a cathode ray tube blank.

A further object is to provide an improved method of applying coatings of uniform electrical characteristics and of uniform appearance in tube envelopes destined particularly for manufacture into cathode ray tubes.

Still a further object of the invention is to provide bulb coating apparatus capable of applying a conductive coating to selected areas within a vacuum tube blank in which striations and other unintended discontinuities in said coated areas are reduced to an absolute minimum.

The foregoing objects, and others which may appear from the following detailed description, are generally attained in accordance with a preferred embodiment of the invention, as shown in the drawings, and described in detail below, in which a rotatable turret arrangement having a number of work supporting chucks arranged to hold cathode ray tube blanks in position for rotation about their axes as the turret is indexed through a number of operating stations. At some of said stations an applicator charged with a flowable coating medium is arranged to be introduced through the narrow neck of a cathode ray tube blank and thereafter moved to contact a desired zone in the interior surface of a frusto-conical portion of the blank. As the blank rotates, a coating of the medium is applied to a given zone. The applicator is thereafter retracted and the blank indexed to the next station where another zone is similarly treated. At certain stations the blank is held stationary while an applicator deposits a longitudinal strip of coating material in the neck of the tube. At others, a reciprocating brush applies a second coating to areas having special configurations.

2

The invention will be more clearly understood by reference to the following detailed description which is accompanied by drawings in which like parts are identified by the same reference numeral, and in which:

Fig. 1 is a plan view of an embodiment of the invention;

Fig. 2 is an elevation in section taken along line 2—2 of Fig. 1;

Fig. 3 is a fragmentary vertical section of the device of Fig. 1 showing in elevation a cathode ray tube blank suspended in place by a chuck and illustrating the relation of the brush operating gear and paint carrier thereto;

Fig. 4 is a side elevational view, partly in section, of another brush operating mechanism and its relation to the paint carrier;

Fig. 5 is a horizontal view in section taken along line 5—5 of Fig. 4 showing the brush of Fig. 4 in its operative position;

Fig. 6 is a fragmentary front view, partly in section, of the mechanism of Fig. 4;

Fig. 7 is a plan view of the portion of the apparatus in Fig. 6;

Fig. 8 is a plan view of a roller type painting mechanism appearing at one of the operating stations;

Fig. 9 is a partial front view of the mechanism shown in Fig. 8;

Fig. 10 is a transverse section taken along line 10—10 of Fig. 9, and showing a paint roller in place in the neck of a tube blank;

Fig. 11 is a side elevational view of Fig. 9;

Fig. 12 is a view in section of a cathode ray tube neck painting apparatus which also shows the successive painting operations performed at the various stations of the entire machine;

Fig. 13 is a fragmentary and partly sectional view in perspective illustrating in detail the operations performed on the neck of the tube by the machine.

As best shown in Figs. 1 and 2, the preferred embodiment of the invention includes generally a centrally disposed supporting structure, generically designated 10, and comprising pedestal 36 the lower portion 11 of which finds its support on a suitable base plate 38 for support of a journal portion 12 in a vertical position. Pedestal 36 may be of generally annular configuration and is laterally provided with an integral flange portion 74 for the support of work station apparatus later described. A planiform upper wall portion 14 of pedestal 36 serves as a supporting base for a plurality of circumferentially disposed brackets 15 which serve to anchor rod-like supports 16 for the fixed support of a second journal member 34 aligned with journal 12 in a vertical position. Journal members 12 and 34 are adapted to receive a tubular member 32 in rotatable relation thereto, member 32 having fixed to the lower end thereof an annular drive plate 30 including a hub portion 17. Member 32 and hub 17 are in turn rotatably supported on a bushing 18, which is supported in a manner below described. Tubular member 32 is adapted to receive a vertical extending rod 42, fixed at the lower end thereof by standard 40, which serves also as the support for bushing 18. The upper end of rod 42 extends from tubular member 32 sufficiently to provide fixed support for a cam track supporting member 44, rod 42 being pinned to standard 40 by any suitable manner, such as the pins shown, to prevent relative rotation between support 44, the supporting base 38, and standard 40 fixedly supported thereby.

The upper end of tubular member 32 extends sufficiently above journal member 34 to provide support for a work holder supporting platform 22, of a pinwheel-like configuration, platform 22 being pinned or otherwise fixed to member 32 for rotation therewith when rotated to various index positions through drive plate 30, in a

manner later described. Platform 22 includes another disk like rim 22' supported from hub 22a by arms 22b. Platform 22 is provided, near the outer margin thereof, and in the rim 22', with a plurality of circumferentially spaced and rotatably mounted work holders 23. Holders 23 include a depending bracket portion 25 including lower chuck arms 84 which terminate in a manner to define a work receiving aperture, as more fully described below, in reference to the structure of Fig. 2. Bracket 25 is provided with an upwardly extending spindle or shaft 20 received in bearing 27 suitably secured within complementary apertures provided in platform rim 22'. The axially extending spindle 20 to extend upwardly through a head sprocket 58 for association with a slip clutch 60 in a manner later described in more detail.

The function of the apparatus thus far described is to provide a turret type mechanism adapted to receive a plurality of chambered work pieces such as the cathode ray tube envelopes shown at 2, and supported in a neck down position for indexed rotation to a plurality of work stations, the mechanism of which is below described. Since rotation of the work is required at some stations and is undesirable at others, the apparatus is cam controlled in a manner to effect rotation at some work stations while discontinuing rotation at other stations. The manner in which this is accomplished, preferably through cam actuated mechanism, is described below. Indexing of the various work holders 23, and the work articles held thereby to the various work stations, designated by figures A through J, Fig. 1, is effected through a drive mechanism connected to a suitable source of power, not shown, in a known manner for rotation of a cam shaft 26 upon which is mounted a barrel cam 24, fixed to shaft 26 for rotation therewith. The surfaces of barrel cam 24 cooperate with lug type cam followers 28, which depend from drive plate 30, in a manner to rotate drive plate 30, and work supporting platform 22 through a sufficient portion of a revolution for indexing with the next successive work station. As platform 22 is progressively indexed in the manner above stated, selective rotation of each work holder 23 is automatically affected in the following manner.

Slip clutches 60, of a known type, and therefore not described in detail, include a stop lug 72 adapted for arresting engagement with pivoted latch bars 62, said bars being retractable to a non-arresting position by rail-like cam tracks 46 which are mounted in substantially annular configuration within the rotational path of clutch actuating bars on levers 62 by a plurality of radial support arms 65 the inner ends of which are fixed to track supporting member 44. Each clutch actuating lever 62, is pivoted at 64, and includes a cam rail contacting portion provided with a roller 66 and a clutch lug arresting portion 62a. As platform 22 is rotationally indexed between work stations, rollers 66 of levers 62 are automatically engaged with or disengaged from actuating contact with cam rails 46, to pivot portions 62a out of the rotational path of lugs 72. When lugs 72 are free to rotate, clutches 60 are maintained in an engaged condition. The length of cam rails 46 and the disposition thereof in respect to the work stations control the rotation of the work holders in accordance with the particular sequence of operations to be performed on the work. The cam rails shown in Fig. 1 are adapted to pivot levers 62 out of arresting engagement with lugs 72 of clutch assemblies 60, shortly after holders 23 start their indexed rotation, for example, shortly after movement of a holder from work station A, at which time roller 66 rides the ramp-like edge 69 of cam rail 46 to pivot lever 62 into the position shown at work station B. Since clutch assemblies 60 are of the type wherein spindle 20 is coupled to drive pinion 58 when actuating arm 62 is pivoted against the urge of spring 70 by roller 66 moving on to cam rail 46, and are disengaged when roller 66 leaves the cam rail thereby engaging bar 62 and lug 72, it follows that since bar 62 is maintained out of arresting

engagement with clutch lug 65 at work station B, the work holder may be rotated by means of drive pinion 58, in the direction shown by the arrow at that station.

Each drive pinion 58 is connected by a continuous chain 54 which extends in generally annular configuration about and in engagement with all pinions 58. Chain 54 is also engaged by a driven pinion 48, rotationally supported in a horizontal position by a drive shaft 53, supported in journaled relation to an upright housing 51. The lower end of drive shaft 53 is connected in a manner not shown through a gear box 52 to a suitable source of power 50 which may be an electric motor and which provides continuous motive power for continuous motion of chain 54. The use of the chain drive permits continued rotation of work holders 23 during rotation from one work station to another, and provides a simple structure for providing interruptable rotational drive to each of the work holders.

As platform 22 is indexed from work station B to work station C, bar 62 continues to be constrained from blocking clutch lug 72 at that station, but upon leaving station C, lever 62 leaves cam rail 46 and is pivoted under the urge of tension spring 70 out of the path of rotation of lug 65 thereby causing reengagement of clutch 60 at work station D. It is therefore seen that the work holder, which is not rotationally driven at work station A, was caused to be so driven at stations B and C and returned to the non-rotational condition at station D. In a like manner, the work holder is caused to rotate at stations E, F, G, and H, with driving power being again rendered ineffective at stations I and J.

As shown in Fig. 2, the work station equipment shown supported by brackets 76, which rest on flange portion 74 of pedestal 76 at diametrical sides thereof, is adapted to perform two different functions during the step by step rotation of the device. The apparatus shown on the left hand side of the drawing includes a vertically disposed brush carrier assembly 78 including a positioning bracket 75, fixed to bracket 76, and a slide rod 77 for the slidable mounting of a brush carrier 79, below described in more detail. A liquid transfer device 82, which may be a paint conveying apparatus, includes elongate member 81, fixed to a standard 80, in turn supported on base plate 38, to position a paint transfer assembly 83 for contacting engagement with the brush apparatus associated with brush carrier 79, and now shown in a disengaged relation. The same type of apparatus is shown on the right hand side of Fig. 2 and includes similar apparatus for mounting the brush carrier 79 for disposition of a brush or other type applicator within the tube blank 2 and for removal therefrom.

Fig. 3 shows in detail the components of a typical painting station. A detailed description of this station follows, and will serve equally well for all stations which perform the same type of operation. Cathode ray tube blank 2 is secured in work-holder 23. Work-holder 23 includes a pair of depending, tong-like chuck arms 84, converging to a semi-circular chuck collar 86 carrying angularly disposed wedge-like supports 88, spaced about said collar at convenient intervals for supporting the conical portion of the blank 2. Collar 86 may be provided with depending chuck extensions 92 carrying neck clamps 90 whereby the axis of tube blanks 2 is maintained coincident with the axis of rotation of spindle 20.

Centrally located beneath the comparatively long tubular neck portion 4 of tube blank 2, is brush 94 which is part of brush carrier structure 78. Located adjacent to brush carrier structure 78 is paint or coating composition carrying apparatus 82.

Brush carrier structure 78 includes various fixed and moving assemblies designed to move brush 94 through neck 4 of tube blank 2 into the main body of the tube, locate brush 94 against a portion of the inside surface for the duration of a particular painting operation, and to remove the brush from the tube blank after the painting operation has been completed.

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6

Brush carrier structure 78 is supported by angle bracket 76 attached to annular pedestal flange 74. Vertical support 156 is mounted in bracket 76 and holds supporting arms 154 and 162. Vertical guide rods 152 are supported between arms 154 and pass through journals in brush assembly carrier 153, serving to guide and support the brush assembly carrier for vertical motion. Attached to vertical extension arm 151 of brush assembly carrier 153 is connecting rod 158 serving to couple linear motion from linear actuator 160, which is mounted on supporting foot 162, to brush assembly carrier 153.

Extending outward from brush assembly carrier 153 is brush carrier bracket 150 in which is mounted vertical brush carrier 138. Also attached to a lower portion of brush carrier bracket 150 is linear brush actuator 164.

Brush carrier structure 138 comprises a guide member 135, including a lower cylindrical portion, center-bored at 133 to receive a brush actuating rod 144, and leading into an upper guard-like extension 139 which serves as a backstop for the brush actuating mechanism, described below. The lower end of member 135 is received in press fit engagement within a complementary aperture provided in brush carrier 150 for rigid support in a vertical position. Centerbore 133 leads downwardly into an enlarged bore 137, for disposition of a helical compression spring 146, which is confined between the upper wall of bore 137 and a retaining collar 148 fixed to rod 144 to bias rod 144 in a downward direction. The upper end of rod 144 carries a fixed collar 143 for pivotal support of one end of link 142, the opposite end of which is pivotally connected to brush actuating arm 140. As more clearly shown in the dotted line work position above, arm 140 is pivoted to extension 139 at 141 and carries at its free end a brush 94 in loose pivotal engagement therewith. As is evident from the above description, movement of rod 144, under the downward urging of spring 146, acts through link 142 to pivot arm 140 laterally to the position of brush contacting engagement with the inner surface of tube blank 2, as shown in the upper part of Fig. 3.

Rod 144 is adapted to be moved upwardly, against the urge of spring 146, by push rod 165, under the control of linear brush actuator 164, which may be pneumatically, hydraulically, or electrically operated. The upward movement of rod 144 to the heavy line position shown transmits retractive movement of brush arm 140 and brush 94 to the position shown for insertion or removal of structure 138 through neck 4 of tube blank 2. Upon insertion of carrier 138 into tube blank 2 (see dotted lines) linear actuator 164 releases, permitting spring 146 to force downward on collar 148 carried by actuating rod 144, thereby drawing downward on actuating link 142 and causing brush lever 140 to swing outward and urge brush 94 against the inner wall of tube blank 2. Indicated by shadowing 167 of the drawing is the path which would be traced on the wall of tube blank 2 by brush 94 wiping against the rotating glass blank.

The ink carrying apparatus 82 is designed to provide rotating ink wheel 98 with a supply of ink, and at the same time to push wheel 98 against one end of the brush, draw it along the surface of the brush, thereby spreading an even coating of ink and then to withdraw the inking wheel from the brush.

Supported by standard 80 on machine base 38 is vertical stand 136 having extensions 134 for supporting inking assembly vertical actuator 132, and vertical guide rods 126. Slidably mounted on vertical guide rods 126 is inking assembly carrier 124. Supported in turn by carrier 124 are carrier extension 128, horizontal guide rod 116, and horizontal inking actuator 122. Attached to carrier extension 128 is connecting rod 130 which receives its driving force from vertical actuator 132. Carried by horizontal guide rod 116 is slidably mounted ink wheel carrier 96. Attached to ink wheel carrier extension 118

is ink wheel carrier connecting rod 120 which is moved by horizontal inking actuator 122.

Supported by ink wheel carrier 96 is ink well 106 containing a water suspension of colloidal graphite such as "aquadag" 104 in which turns ink delivery wheel 102. Also supported by ink wheel carrier 96 is coating wheel 98 driven by motor 100 and knife blade support 112, in which doctor blade 108 is moved by screw 110. Inasmuch as delivery wheel 102 is in contact with coating wheel 98, ink from well 106, which is picked up by wheel 102 as it idles, is delivered to coating wheel 98. The thickness and evenness of the ink on coating wheel 98 may be regulated by varying the position of doctor blade 108 closer or further away from the periphery of wheel 98.

In operation at the beginning of the cycle when tube blank 2 is moved into position over brush 94, inking assembly carrier 124 is in its uppermost position, having been placed there by vertical actuator 132. Horizontal actuator 122 then moves ink wheel carrier 96 horizontally so that ink wheel 98 contacts brush 94. Vertical actuator 132 then causes inking assembly carrier 124 and inking wheel carrier 96 to descend, the rotation of coating wheel 98 then delivering a supply of ink to brush 94 along its entire length. Upon completion of the coating delivery stroke, horizontal actuator 122 then returns coating wheel carrier 96 to its outermost position and subsequently assembly carrier 124 is returned to its uppermost position by vertical actuator 132. The path described by coating wheel carrier 96 is shown in the rectangular trace 114 to the right in the drawing.

Upon completion of the coating cycle as described above, the painting cycle described in connection with the description brush carrier structure 78 begins, and the whole cycle at this station is completed upon return of brush carrier 138 to its lower position. Then tube blank 2 is indexed to the next operating station, and a new tube blank positioned at this station for the same operation.

In Figures 4 to 7 inclusive, details are shown of an apparatus to be located at a suitable station for the purpose of applying coating to second anode connector button 212 located in the side of tube 2. The second anode is formed by the conductive coating of graphite on the inside of the cathode ray tube, and careful application of graphite in the vicinity of contact button 212 is necessary in order to obtain a good connection between button 212 and the anode coating. This coating step is complicated by the fact that during the process of inserting button 212 in the wall of blank 2, a small surrounding recess is formed in the glass.

The apparatus shown in Fig. 4 is a variation of that shown in Fig. 3, and is specially adapted for the purpose described above. Fixed to pedestal flange 74 is angle standard 76 on which is mounted brush assembly stand 182. To standard 76 and stand 182 are attached extensions 180 for supporting vertical linear actuator 178, and extensions 184 for holding vertical guide rods 172. Bracket 188, which is also mounted on support 182, bears motor 190, gear reduction box 192, shaft 194, and pivot block 202 (these are more clearly shown in Figs. 6 and 7).

Slidably mounted on vertical guide rods 182 is brush assembly carrier 170 which is formed in the nature of a yoke (see top view, Fig. 7) and which contains passages for slidable acceptance of guide rods 182. Attached to the upper end of carrier 170 is extension arm 174 to which is attached one end of connecting rod 176 for transferring motion from linear actuator 178 to carrier 170. Carrier 170 also bears forked member 168 in which brush carrier 166 is rotatably mounted, and bracket 219 for mounting brush actuator 220.

Mounted on motor bracket 188 is an assembly for producing a reciprocating motion to be applied to brush carrier 166. More clearly shown in Figs. 6 and 7 are drive motor 190, gear reduction box 192, shaft 194, and

connecting rod 196. Rod 196 is eccentrically connected to shaft 194 by pin 195 for generation of the reciprocating motion at the other end of rod 196, where pin 197 connects rod 196 to channel member 198.

The construction and operation of the brush carrier is otherwise similar to that described previously in connection with Fig. 3. Spring loaded brush actuating rod 222 is moved vertically by motion transmitted from brush actuator 220 by actuator push rod 218 and push rod thrust bearing 219. Thrust bearing 219 is inserted in the linkage to facilitate oscillation of brush carrier 166. Actuating linkage 214 is connected between the upper end of actuating rod 222 and a point of advantage on pivotably mounted brush lever 216. The outer end of lever 216 supports pivotably mounted brush 204. Thus, downward motion of actuating rod 222 serves to lower brush 204 against the inner surface of tube blank 2, and upward motion serves to raise brush 204 into a position for retraction through tube neck 4.

Brush assembly carrier 170 is shown here in its topmost position, that in which it would be during the painting operation. Lowering of carrier 170 is accomplished by means of linear actuator 178 and connecting rod 176. During raising and lowering, roller 206 on reciprocating lever arm 208 is free to travel in channel 199 of channel member 198. At a point slightly below channel member pivot pin 200, travel in channel member 199 ceases and the roller carries on into fixed channel member 224, which is immovably attached to pivot block 202. Oscillating motion of brush carrier 166 may thus be arrested so that application of fresh "aquadag" to brush 204 is facilitated. Inking assembly 82, similar in description and operation to that described in Fig. 3 above, may be used to coat brush 204.

Fig. 5 is a top section view of the cathode ray tube blank 2 taken when brush 204 is in position over contact button 212. The scope of the oscillating motion required to be applied to brush 94 to obtain satisfactory coating of area 210 is indicated by the arrows.

In Figs. 8 to 13 an apparatus for use at another station on the machine and which is suitable for outlining "windows" on the wall of cathode ray tube blank 2 is shown. In the manufacture of cathode ray tubes, it is customary to use a "getter" to help remove residual gases and to preserve the high vacuum necessary to the proper operation of a cathode ray tube during its life. Windows, a part of which are painted by the below described portion of the invention, permit flashing the "getter" directly on to the glass wall of the tube in an area free from "aquadag." Thus it is possible by visual inspection to observe whether the "getter" has been properly flashed. Strips painted by this apparatus, when connected with circumferential bands applied by an apparatus such as that disclosed in Fig. 12 produce a pair of suitable "getter" receiving windows.

The apparatus differs from that previously described, in that roller 250 is used to apply the "aquadag" to the wall of the tube in lieu of the brush previously used, although a brush would also be a suitable means.

Attached to annular flange 74 of pedestal 36 is angle bracket 76 to which in turn is attached upright stand 234. Supporting feet 262 on stand 234 support vertical guide rods 260 on which the yoke of painting assembly carrier 258 is slidably mounted; supporting feet 268 attached to stand 234 and bracket 76 hold linear actuator 266. Motion of linear actuator 266 is transmitted from actuating rod 264 to carrier 258 by carrier extension arm 257.

Attached to the upper end of carrier 258 is roller rod bearing block 259 in which is pivoted roller rod shaft 256, to the outer end of which is affixed roller rod support 254. Carried in roller rod support 254 is roller rod 252 an elongate member having at its upper end freely turning applicator roller 250 and at its other end cam following roller 280. Also firmly attached to car-

rier 258 is extension 261 which holds supports 284 for spring loaded centering members 282.

Also attached to upright stand 234 are lateral support members 232 and 270. The uppermost of these, support 232, has forward extending integral arms 233 to which is attached the mechanism for coating roller 250. To lower support member 270 are attached forward extending side support members 272. Attached to the forward ends of side members 272 is transverse support 271 on which are mounted right and left cam support blocks 274 and 275. Secured by pins 278 in a channel of cam support blocks 274 and 275 are cams 276 and 277. Slots 265 and 273 in cams 276 and 277 receive cam stop pins 267 and 279 which are anchored to transverse support 271. Cam spring fingers 283 and 285, mounted on transverse support 271, anchor cam return springs 286 and 288, which are attached at their other extremities to cams 276 and 277. By this means, cam 276 is continually urged downward onto its stop pin 267, and cam 277 is urged upward onto pin 279.

The plan view of Fig. 8 shows a view of the paint supply mechanism used with this adaptation of the invention. This structure was omitted from the other views (Figs. 9, 10, and 11) for the sake of simplicity.

Attached to forward extending integral arms 233 is paint supply stand 236. Mounted on stand 236 is linear actuator 238 and guide members 241 which are spaced to provide a track for slidable motor mount 243. Connecting rod 240 serves to transfer linear motion from actuator 238 to integrally formed bracket 242 on mount 243. Carried by motor mount 243 is motor 244 having shaft 245 terminating in continually rotating delivery wheel 246. Motor 244 and wheel 246 are thus subject to transverse motion from actuator 238. This positions wheel 246 so that it is in position to contact painting roller 250, or to receive a new supply of "aquadag" from supply wheel 226. Wheel 226, rotatably mounted in container supporting bracket 228, turns freely when contacted by delivery wheel 246 and transfers "aquadag" from a pool in paint container 230 to delivery wheel 246, thereby preparing it to coat roller 250.

Operation of the above described window painting apparatus consists of a number of timed sequential events. Starting with actuator 266 operated to lower painting assembly carrier 258 to its bottom position, "aquadag" delivery wheel 246 is moved by operation of actuator 238 to contact supply wheel 226 and then is moved to contact roller 250, delivering ink. After delivery of "aquadag" to roller 250, delivery wheel 226 is returned by actuator 238 to its original position so that the inking assembly does not interfere with motion of the remaining apparatus. Painting assembly carrier 258 is then raised by actuator 226, carrying along with it rod 252 which, retained in a vertical position by spring loaded centering members 282, passes into blank 2. As carrier 258 rises further, cam follower roller 280 strikes cam surfaces 269 and 281 of cams 276 and 277. Pin 279 prevents upward deflection of cam 277, but upward motion of cam 276 is permitted to the extent of the length of slot 265 co-acting with stop pin 267. Cam follower roller 280 is therefore deflected to the left and paint roller 250 at the opposite end of roller rod 252 is thus forced to the right against the wall of neck 4 of tube 2. Upon completion of passage of cam follower 280 through cams 276 and 277, recentering of rod 252 is accomplished by centering devices 282. Lines 287 at the right of Fig. 9 indicate the path traced by paint wheel 250 on its upward and downward courses. Distance 289 indicates the strip of painting just completed.

Downward motion of carrier 258 upon reversal of motion by actuator 266 causes roller 280 to be deflected to the right by a similar but reversed action of cams 276 and 277. Paint roller 250 thus traces strip 291 on the left hand side of tube blank neck 4. Continued downward motion of carrier 258 first frees cam follower 280

of contact cams 276 and 277, thereby causing recentring of lever 252, and then removes rod 252 from neck 4. The cycle is then repeated as turret 44 rotates to present a new tube to this position.

Fig. 12 shows a modified brush applicator arrangement which is designed to paint narrow circumferential bands around the inside of the neck of the tube at either end of vertical strips 289 and 291 painted by the mechanism of Fig. 9. This mechanism has painting assembly carrier 290 which may be attached to a vertical actuating mechanism such as that attached to upright stand 182 in Fig. 3. Similarly, paint carrying apparatus 82 of Fig. 3 could be used to supply ink to brush 304 of this assembly.

Fixed in assembly carrier 290 is brush carrier 292 having a channeled brush carrier extension 293 for receiving a pivotably mounted brush lever 294. Attached to the base of brush lever 294 is extension arm 296, the outer end of which is connected through actuating link 298 to collar 300. Collar 300 is secured about tubular slide 302 which is slidably fitted in recess 303 in the lower end of brush carrier 292. Tubular slide 302 is spring loaded downward by internal compression spring 308. Linear actuator 310 is anchored to carrier 290 and normally applies force to collar 300 through connecting rod 306, thereby keeping brush 304 out of contact with the tube neck 4. Release of compulsion by actuator 310 permits downward motion of collar 300 under pressure from spring 308. Collar 300 draws down on link 298, which in turn moves lever 244, forcing brush 304 into contact with neck 4. Brush 304 has bristles at either end but none in its center, so that two parallel bands may be painted to complete windows started by the mechanism of Fig. 9. Tube blank 2 is rotated at the station where this brush is employed, thus producing circumferential bands.

Fig. 12 also illustrates diagrammatically tube 2 after it has passed through the machine and stopped at each of 10 stations. The areas covered have letters corresponding to those of the stations at which a painting operation occurred and are thus designated consecutively B to I. It should be pointed out that each succeeding layer of paint actually overlaps the preceding one as shown in Fig. 4 so that the surfaces are conductively united. The strip separation indicated in Fig. 12 is merely intended to illustrate the step by step process. Fig. 13 represents a closeup view of the windows formed in the neck by strip bands 291 and 289 of painting operation I and the circular bands of painting operation H.

The various operating elements of the invention having been described in detail, the overall operation of the machine is now briefly considered.

The tube blank 2 is first manually loaded at station A. The turret is then indexed to station B where the tube is rotated during the application of the first circumferential band of paint. Upon completion of this operation, the tube is indexed to the next station to receive band C and so forth on down the tube. At station D rotation of the tube is stopped while the apparatus of Fig. 4 applies the coating around contact button 212.

Bands E, F, and G are applied as before, while the tube rotates. Note that at stations F and G, where lower portions of the tube are painted, it may be mechanically advantageous to substitute the brush carrier apparatus of Fig. 12 for that of Fig. 3, but that the applicator shape of Fig. 3 should preferably be used, rather than that of Fig. 12. In order to paint vertical strips 291 and 289 on the neck of the tube blank, rotation of spindle 20 is stopped at station I, and the bands which complete getter windows 311 and 312 are painted at station H with the tube blank rotating. At station J the tube is removed from the machine.

It should be noted that provisions are made for the number of work holders 23 to match the number of operating stations so that every time the machine indexes, one tube is at some stage of the operation.

While disclosure of the invention above has shown the use of brushes or rollers in specific locations for the application of the painting medium "aquadag," it is not intended thereby to limit the invention to those particular applying means. Other types of applicators can be used, such as suitably mounted strips of cloth or other absorbent medium, as well as simple flat surfaces of a yielding or non-yielding nature.

Similarly, rollers such as that in Figs. 9 and 11, or rollers having a wider rolling surface pivotably mounted with their axes substantially parallel to the brush lever may be used. Note also that a brush or other device could be substituted for the roller of Figs. 9 and 11.

Further, it is not intended that the machine should be limited to the application of "aquadag" to the inside surfaces of a cathode ray tube blank, but rather that it may be used for the application of other liquids to the inside surfaces of many different container-like objects having a substantially circular cross-section at any of the points to which a coating is to be applied.

While the correlation of the various component parts and assemblies above described, has not included a detailed showing or description of mechanism for controlling the timing therebetween, it will be understood that such timing may be accomplished in any one of a number of known manners, and by employment of known equipment. The indexing of the turret by barrel cam 24 is on an intermittent basis. That is the cam is provided with a comparatively long "dwell" portion and a steep indexing portion so that the turret is stationary for the major portion of a revolution and is quickly indexed during the remainder of the revolution. The timing is so arranged that with the work holders loaded, and the power turned on, the applicator mechanisms, which may be of different types, operate to perform their intended functions while the index dwells. Upon completion of the applicator operations, and retraction of the applicators to the non-operating position, the applicator mechanisms are idle while the barrel cam indexes the rotatable work holder assembly to the next work station. During this indexing operation, the lever actuated clutches are controlled by engagement or disengagement with the fixed cam rails to automatically time the application to or removal of driving power from the individual work holder assemblies. Upon completion of each indexing operation, power is appropriately re-applied to the applicator mechanisms which operate to perform the second of the sequence of operations. The cycle is repeated until each article has moved through all work stations at which time the articles are normally removed and the holders reloaded.

While programming mechanism may be used, coupled to the index cam drive to control operation of the painting mechanism it will be apparent that the control of the various actuators may be manual as far as illustrating the operation of the machine is concerned and since the programming mechanism is no part of the present invention, it has not been illustrated.

Finally, it is intended that the form of the invention herewith shown and described is to be taken as a preferred example, and that various changes in shape, size, and arrangement of parts may be used without departing from the spirit of the invention, or the scope of the subjoined claims.

Having thus described the invention, what is claimed is:

1. An applicator apparatus, the combination of an elongate tubular member, a rod-like element disposed within said tubular member in slidable relation thereto, an arm pivoted to said tubular member adjacent one end thereof, an applicator device at one end of said arm, a compression spring disposed within said tubular member at the opposite end thereof, a link element connecting said arm at a point spaced from said pivotal connection to said rod for translation of axial movement of said rod to pivotal movement of said arm, means connecting said

compression spring to said tubular member and to said rod to bias said rod in a direction to pivot said arm outwardly from said tubular member, and means coupled to said rod for moving said rod against the urge of said spring to pivot said arm to a position of substantial alignment with said tubular member.

2. In a device for sequentially subjecting a plurality of chambered articles to a plurality of applicators for application of material to the surfaces defining the chambers therein, the combination with a plurality of article holders, means for the progressive indexing of said holders to positions of registry with said applicators, and means coupled to each of said applicators for movement thereof into the chamber of articles held by said holders, means for moving each said applicator to engage the surface defining said chamber, and means for rotating one or more of said articles while an applicator is held in contacting engagement with said chamber defining surface.

3. In paint applying equipment, the sub-combination comprising a support member, a pair of guide rods attached to said support member to extend upright therefrom, a carrier carried by said guide rods in slidable relation thereto, a linear actuator connected to said carrier for reciprocation of said carrier along said guide rods, an elongate element pivotally attached at one end to said carrier to extend outwardly therefrom, an applicator member movably connected to the other end of said elongate member, cam means coupled to said pivotally mounted elongate element for lateral deflection thereof in one direction upon movement of said carrier along said guide rods in one direction, and for deflection of said element in an opposite direction upon reversal of movement of said carrier, and means operative by said carrier when moved to a position at one extreme end of its stroke for recentering said elongate element.

4. In a device of the character described, the subcombination including a pair of guide rods and means supporting said guide rods in mutually parallel spaced relation, a carrier mounted to straddle said guide rods in slidable relation thereto, an elongate element pivotally attached to said carrier midway between said rods to extend beyond the ends thereof, resilient means normally maintaining said element in parallel spaced relation centrally of said rods, an applicator movably attached to one end of said elongate element, a cam follower attached to the opposite end of said elongate element, and cam means pivotally supported by said rods to extend transversely thereof and into the path of movement of said cam follower, said cam means comprising a pair of arms, each of which is pivoted adjacent one of said rods to extend into the space therebetween, said arms being provided at the free end thereof with cam surfaces, stop means limiting pivoting on one of said arms to one direction from a position normal to said rods, stop means limiting pivoting of the other of said arms to an opposite direction from a position normal to said rods, and means normally biasing said arms against said stop means and normal to said rods, whereby upon movement of said carrier in a direction to move said cam follower against said arms, said elongate element is pivoted outwardly against the cam surface of an arrested arm with the opposite arm yielding, and upon movement of said carrier and cam follower in the opposite direction, said elongate element is oppositely cammed to pivot said element, and the applicator mounted to the opposite end thereof in the opposite direction.

5. In turret mechanism adapted to progressively position work supporting holders at successive work stations, the combination with a plurality of annularly disposed work stations, each station comprising work engaging apparatus, and means at each work station for vertically moving said work engaging apparatus from a retracted position of nonengagement with work to an elevated position of engagement therewith, of means for supporting

work in vertical alignment with said apparatus and including a support member mounted for rotation in a horizontal plane spaced above said work engaging apparatus, means for rotationally indexing said support member, a plurality of work holders mounted for rotation in respect to said support member to depend therefrom, each said holder being adapted to support an article in alignment for engagement therewith of said work engaging apparatus, drive means for the rotation of said work holders, individual clutch means interposed between said drive means and each work holder for selective connection of said drive means, and cam means for selectively actuating said clutch means, said cam means being operable in response to rotational indexing of said support member.

6. The device of claim 5, wherein each said clutch means includes a slip clutch, one element of which is provided with an exposed lug, rotatable with said clutch when in an engaged position, and adapted, when constrained against rotation, to disengage said clutch, a plurality of clutch actuating levers pivotally mounted on said support member for movement from a lug arresting position to a position of non-engagement therewith, means biasing said levers to said lug arresting position, and an arcuate cam rail, fixedly supported within a path traversed by said biased levers to pivot said levers, upon engagement with said cam, into a position of non-engagement of said lug, whereby said work holders are rotatably driven only when said levers engage said cam.

7. In a device of the character described, the combination with an applicator element, and means for fixedly positioning said element with a work surface thereof disposed in a vertical plane, of means for feeding flowable material to said work surface comprising a container for said flowable material, a transfer roller mounted for rotation in a vertical plane above said container, means for driving said roller, means for feeding said material to said transfer roller, and means for moving said roller and container into a position for engagement of said roller with the upper portion of said applicator work surface, means for moving said roller and container downwardly through a vertical plane in wiping engagement with said work surface for transfer of material thereto, and means for moving said roller and container to a position of non-use laterally from the vertical plane of said work surface.

8. The device of claim 7, wherein said means for feeding flowable material to said transfer roller comprises a feed roller, disposed within said container for partial emersion within the material therein, and in surface contacting engagement with said transfer roller to be driven thereby for feeding of material to said transfer roller.

9. An applicator adapted to apply a coating to internal surfaces defining a chamber having in combination, an arm, an applicator carried by one end of said arm, a member mounted for reciprocation, means pivotally mounting said arm to said member at a point intermediate the ends of said arm, and means mounted adjacent said member to cause pivotal movement of said arm in opposite directions respectively, in response to movement of said member in opposite directions.

10. A device of the character described having in subcombination a work holder comprising a support member having a pair of arms attached to a rotatable member and diverging to receive an enlarged portion of a work piece, said arms converging to receive an extending neck portion of said work piece and maintain said neck portion in coaxial relationship with said rotatable member.

11. A work supporting device for positioning elongated neck type electron tube blanks in a vertically positioned neck-down position, said device having in combination, a supporting frame including a portion adapted for rotational mounting to associated apparatus,

13

a pair of arms depending from said mounting portion and spaced apart sufficiently to receive the body of a tube blank therebetween, said arms leading downwardly into inwardly divided portions and terminating at a position to define an aperture of a width to permit passage of the tube blank neck therethrough, and an alignment member including a flanged base, adapted to be received marginally of the aperture defining ends of said arms, a plurality of circumferentially disposed guides supported to depend from said flanged base and to engage the neck of a tube blank supported in said device, and a plurality of upwardly extending work supports of a configuration to snugly receive the body portion of a tube blank.

12. A device for coating the interior surface of a container having in combination, means for supporting a container, the interior of which is accessible only through a dimensionally restricted transfer port, an elongate element, an applicator operatively connected to one end of said element, means for maintaining said applicator adjacent to said element for insertion within said container in non-contacting engagement therewith during passage through said port, means for moving said actuator outwardly from said element and into contacting engagement with inner wall surfaces of said container, means for oscillating said element to effect oscillatory contacting movement of said applicator over a portion of said inner surface, means for returning said applicator to a position adjacent said element, means for retracting said element and said applicator from the interior of said container, and means adjacent the path of said applicator movable into engagement with said applicator for applying coating material thereto.

13. An apparatus for internally coating a hollow receptacle having a long narrow neck portion, means for supporting said receptacle for rotation about an axis concentric with the axis of said neck portion, coating means movable axially through said narrow neck and including an elongated supporting element, a lever pivotally connected to one end of said elongated element, an applicator member adapted to apply a coating to the interior surface of said receptacle, means operatively connecting said applicator member to the other end of said lever for relative movement therebetween, means operable from the exterior of said receptacle for pivoting said lever in a plane radial to the axis of said neck to a position with said feed member in contacting engagement with a selected portion of the inner surface of said receptacle and means for relatively rotating said receptacle and said applicator means about a common axis and means external of said hollow container for applying coating material to said applicator member, said last mentioned means including a paint roller adapted to be moved into engagement with said applicator member and swept over the length of said applicator member.

14. An apparatus for internally coating a hollow receptacle having a long narrow neck portion, means for supporting said receptacle for rotation about an axis concentric with the axis of said neck portion, coating means movable axially through said narrow neck and including an elongated supporting element, a lever pivotally connected to one end of said elongated element, an applicator member adapted to apply a coating to the interior surface of said receptacle, means operatively connecting said applicator member to the other end of said lever for relative movement therebetween, means operable from the exterior of said receptacle for pivoting said lever in a plane radial to the axis of said neck to a position with said feed member in contacting engagement with a selected portion of the inner surface of said receptacle and means for relatively rotating said receptacle and said applicator means about a common axis, said means for supporting said receptacle including a supporting frame adapted for rotational mounting, a pair of arms extending along the direction of the

14

axis of rotation of said frame and spaced apart sufficiently to receive the body of said receptacle therebetween, said arms therebeyond converging toward a position to define an aperture of a width to permit passage of the neck of said receptacle therethrough and an alignment member connected to the end of said arms and extending along the neck of said receptacle to engage said neck at a position remote from said aperture whereby the neck of said receptacle is constrained to rotate about an axis coincident with the axis of said supporting frame.

15. A device for coating the interior surface of a container having in combination, means for supporting a container, the interior of which is accessible only through a dimensionally restricted transfer port, an elongate element, an applicator operatively connected to one end of said element, means for maintaining said applicator adjacent to said element for insertion within said container in non-contacting engagement therewith during passage through said port, means for moving said actuator outwardly from said element and into contacting engagement with inner wall surfaces of said container, means for providing relative rotational movement between said container and said element, means for returning said applicator to a position adjacent said element, means for retracting said element and said applicator from the interior of said container, and means adjacent the path of said applicator movable into engagement with said applicator for applying coating material thereto.

16. A device for coating the interior surface of a container having in combination, means for supporting a container, the interior of which is accessible only through a dimensionally restricted transfer port, an elongate element, an applicator operatively connected to one end of said element, means for maintaining said applicator adjacent to said element for insertion within said container in non-contacting engagement therewith during passage through said port, means for moving said actuator outwardly from said element and into contacting engagement with inner wall surfaces of said container, means for oscillating said element to effect oscillatory contacting movement of said applicator over a portion of said inner surface, means for returning said applicator to a position adjacent said element, means for retracting said element and said applicator from the interior of said container, and means adjacent the path of said applicator movable into engagement with said applicator for applying coating material thereto, said last mentioned means comprising a container of coating material having a first roller immersed in said material, a second roller in contact with said first roller and means for laterally shifting said last mentioned means to bring said second roller in contact with said applicator and sweeping it over the length of said applicator.

17. A device for coating the interior surface of a container having in combination, means for supporting a container, the interior of which is accessible only through a dimensionally restricted transfer port, an elongate element, an applicator operatively connected to one end of said element, means for maintaining said applicator adjacent to said element for insertion within said container in non-contacting engagement therewith during passage through said port, means for moving said actuator outwardly from said element and into contacting engagement with inner wall surfaces of said container, means for providing relative rotational movement between said container and said element, means for returning said applicator to a position adjacent said element, means for retracting said element and said applicator from the interior of said container, and means adjacent the path of said applicator movable into engagement with said applicator for applying coating material thereto, said last mentioned means comprising a

15

container of coating material having a first roller immersed in said material, a second roller in contact with said first roller and means for laterally shifting said last mentioned means to bring said second roller in contact with said applicator and sweeping it over the length of said applicator. 5

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