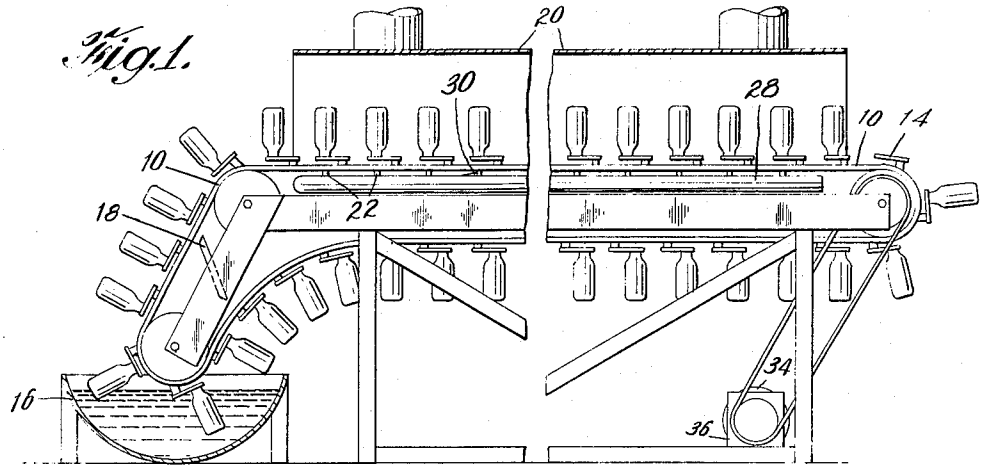
May 31, 1966 W. P. MAYER ETAL 3,253,943

BOTTLE COATING MACHINE

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Fig. 1.



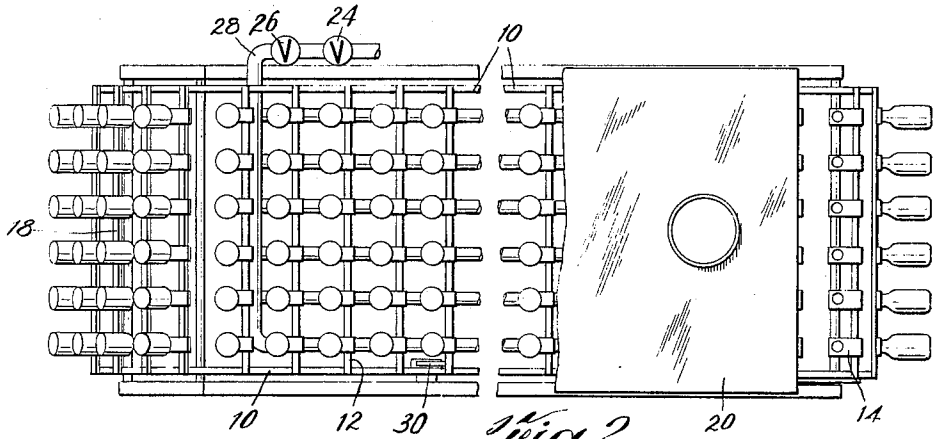


Fig. 2.

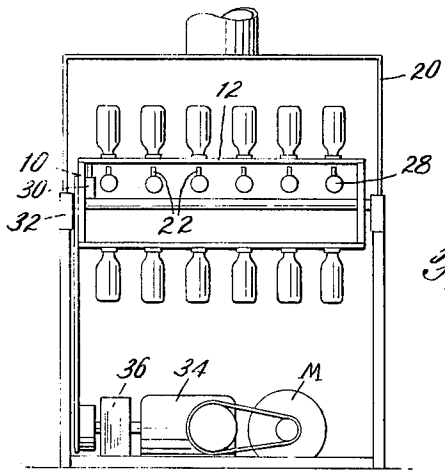


Fig. 3.

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BOTTLE COATING MACHINE

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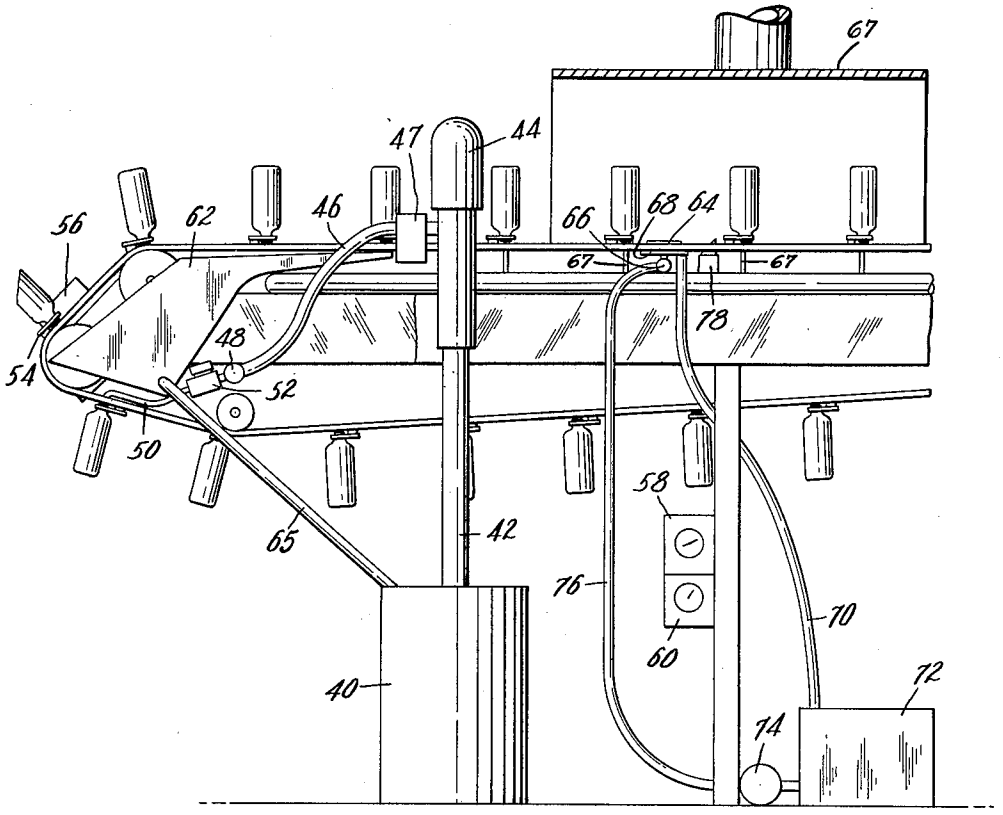


Fig. 4.

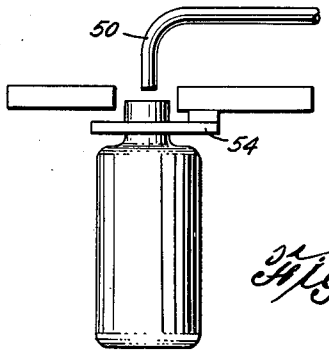


Fig. 5.

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BOTTLE COATING MACHINE

Filed March 4, 1963 3 Sheets-Sheet 3

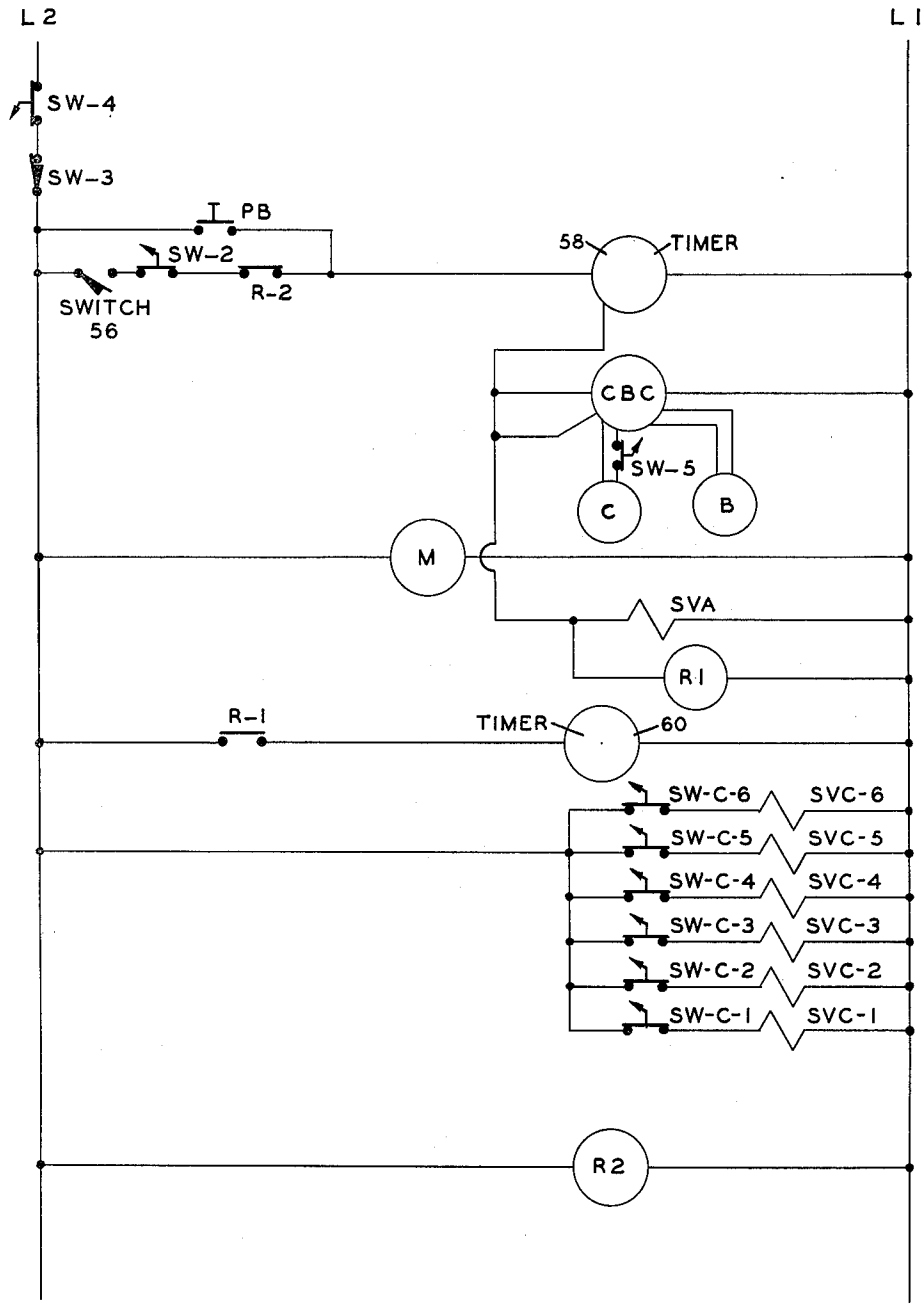


Fig. 6.

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BOTTLE COATING MACHINE

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Filed Mar. 4, 1963, Ser. No. 262,501
15 Claims. (Cl. 117—94)

This invention relates to bottle coating, and more particularly to method and apparatus for coating plastic bottles.

There are many products not packagable in polyethylene. Oxygen and many solvents and essential oils permeate polyethylene bottles giving rise to volume, flavor or odor loss or product damage by oxidation. In many cases, these problems can be eliminated by applying a barrier coating on the surface of the polyethylene.

The main object of the present invention is to provide method and apparatus for applying such coating to bottles.

Because a polyethylene bottle is a low-cost, disposable package, the coating costs must be kept low. It is also desirable to provide an inner and outer coated bottle. This demands a fast, simple, versatile process which produces a quality coating.

Unique features of our coating process are:

(1) Use of an arcuate dipping-draining motion: This avoids tears and puddles which result in coating imperfections and slow drying. The bottle neck becomes the final drain point for the coating.

(2) Rapid setting and drying to give a uniform continuous coating by blowing air into the bottle while heating the outside of the bottle.

(3) Holding the bottle by the outer edge of the neck by means of a hollow work holder, thereby allowing simultaneous inner and outer coating by coating and draining all bottle surfaces in one step.

(4) Drying of the entire inner and outer bottle surface except at the points of contact with the work holder by controlling drying conditions. The bottle is thus dry enough to be handled for removal from the work holder, but the outer neck area remains wet so as to prevent adhesion of the bottle to the work holder.

In our dip process, the bottles are held by the neck. Any size or shape bottle having the same neck finish can be handled by a single size work holder. This allows very low work holder inventory and permits different bottles with the same neck finish to be coated interchangeably on the same line.

Inner and outer coating of bottles by spray requires at least two separate coating steps. The bottles, held by the base, would first be internally sprayed, force dried, and then transferred to another work holder holding the bottles by the neck for the outer coat, followed by a second drying step. The dipping process does all these operations in one step.

Our dip process is also more versatile than spraying. Many bottle types such as pinch-waist, oval, hollow handle and offset neck are very difficult to line by spray. These bottles are no particular problem to our dip process provided the shoulder has sufficient pitch to allow drainage.

Another advantage of the dip process is its simplicity, allowing operation by unskilled workers. There is little to go wrong once coating viscosity is adjusted and oven temperatures are set. Spraying, particularly internal, is more critical in that spray pattern and volume must be carefully adjusted and maintained for a satisfactory coating job.

The dipping process can produce coated bottles at least as fast as most commercial spray or flushing machines.

The limiting factor may be the rate at which the bottles can be loaded and unloaded.

In the drawings:

FIG. 1 is a side elevation of the preferred embodiment of apparatus according to, and for carrying out the method of, the present invention;

FIG. 2 is a plan of the machine shown in FIG. 1;

FIG. 3 is an end elevation of the same;

FIG. 4 is our end elevation of a modification.

FIG. 5 is a side elevation showing in greater detail the liquid filling station in the modification illustrated in FIG. 4; and

FIG. 6 is a schematic electrical diagram of the electrical control circuitry comprised in a system according to the present invention illustrated in FIG. 4.

The machine consists of two parallel conveyor chains **10** between which are suspended at equally spaced intervals cross-bars **12**. Each cross-bar supports a series of bottle holders **14**. Spacing between cross-bars and between bottle holders is determined by the size of the bottles to be coated.

In operation the bottles, held by the outside edge of the neck, are carried into a dip tank **16** where the bottle is submerged and allowed to fill with coating solution. The bottles emerge from the tank oriented neck down with their longitudinal axis about 20° above horizontal. This allows most of the coating to flow into drip pans **18** for recycle, and allows the inner and outer surfaces of the base to drain free of large droplets or puddles. Next the bottles assume an inverted position, allowing the remaining coating to drain, and leaving the bottle coated overall with a uniform wet film.

Setting and drying of the coating is achieved by conveying the bottles into an oven **20** where the outsides of the bottles are heated while the insides are purged with air issuing from a series of air jets **22**. Best quality of the inner coating is obtained when the purging air is at room temperature rather than heated. Ventilation of the inside of the bottle removes solvent vapors as they are generated and avoids recondensation on the bottle wall with resultant wash down of coating.

The conveyor moves intermittently by means of an indexing mechanism. The conveyor speed, while in motion, is about 0.25 foot per second. The time interval during which the conveyor is stopped is controlled by an adjustable timer and usually ranges from about 8 to 16 seconds, depending on the time needed to fill a submerged bottle.

Each time the conveyor stops, one bank of bottles is submerged in the coating, and each bottle in the drying oven is stopped directly over an air jet. By means of a solenoid valve **24**, the ventilating air is off while the bottles are moving, and on while the bottles are stopped. This prevents the air blast from distorting the coating on the exposed shoulders of moving bottles. A throttling valve **26**, allows control of volume of air fed to the air jets. A manifold system **28** supplies air to the jets.

Indexing is triggered when a moving cross-bar depresses a pulse-type microswitch **30**. (A pulse-type switch, when depressed, closes momentarily and reopens.) The pulse causes timer **32** to start timing: clutch **34** deenergizes, brake **36** energizes (conveyor stops), solenoid air valve opens (turns air jets on).

Timer times out: clutch energizes, brake deenergizes (conveyor moves), solenoid air valve closes (turns air jets off). Conveyor moves until next cross-bar depresses microswitch and repeats cycle.

One of the problems in simultaneously coating the inner and outer surfaces of a bottle is that of holding the bottle through the dipping and drying steps without ruining the appearance of the coating at the point of contact, or adhering the bottle to the work holder during the drying.

This problem is largly overcome by adjusting drying conditions such that the entire bottle is dried except for the threaded area of the neck in contact with the work holder. This area remains wet longer than the rest of the bottle because solvent is trapped by the work holder. On leaving the drying oven, the bottle, dry enough to handle, is removed from the work holder and transferred to a curing oven. The coating on the now exposed threaded area flows out and dries quickly.

The emptied work holder can be immediately refilled with another bottle to repeat the dip cycle or passed through a cleaning station before refilling. In continuous running, inline cleaning of work holders appears necessary. The work holders **14** are preferably of the screw-in type.

In cases where only the outside of the bottle is to be coated, the coating level is adjusted so that the bottle is submerged only so far as to cover the shoulders. The bottle is then drained and dried as shown in FIGURE 1 except that the air jets may be turned off and the conveyor need not be indexed. Conveyor speed is adjusted to allow drying within the length of oven available.

Where only the inside of the bottle is to be coated, the dip tank is emptied and the dipping end of the machine is equipped with a filling station so that the bottles are pressure-filled at the same point at which they would otherwise be filled by submersion in the coating. In that case, the dip tank acts as a sump from which coating is recycled to the filling device pump. After being filled, the drain and drying technique would be the same as described earlier.

Pressure filling can also be used to speed the indexing cycle when used in place of filling by submersion.

Very large containers in the half-gallon size and larger are somewhat awkward to dip coat in the manner described previously.

For these containers, it is more convenient to coat the outside by flowing or flooding, and the inside by flushing thereby coating the bottle without actually submerging it or filling it. The coating is then drained and dried in the same way described earlier.

Technique for automatic flow-coating and/or flush coating on the dipping machine has been successfully carried out. When it is desired to coat the interior of the bottles without necessarily coating the outside thereof, the form shown in FIGURE 4 is employed. The coating is contained in a supply tank **40** into which depends the inlet pipe **42** of an air operated positive displacement pump **44**. The pump outlet pipe **46** passes through a line strainer **47** to a coating manifold **48** for filler tubes **50**, each having a solenoid valve **52**. The conveyor moves until cross-bar **54** trips the limit switch **56**. Indexing timer **58** beings timing, stops the conveyor and opens solenoid valve **24** which feeds ventilating air to bottles in the oven.

Simultaneously fill timer **60** begins timing, and opens coating solenoid valves **52**. Pressure in coating manifold **48** drops. Pump **44** begins pumping the coating through filler tubes **50** into the bottle in the fill position.

The fill timer **60** times out, being set to allow bottles to fill ¾ full in about 6 seconds. Coating solenoid valves **52** close, pressure in coating manifold **48** builds up and stops the pump **44**.

The indexing timer times out after about 13 seconds. The conveyor moves until next cross bar **54** trips the limit switch **56**. Bottles in fill position move up and invert to 45° drain position. Coating drains from bottles into drain pan **62**, from which it flows through tube **65** back into coating supply tank **40**.

Drips of coating which form on the lip of the bottle while draining must be removed. This should preferably be done after the bottle has completed draining but before the coating has set. If this is neglected, the coating dries to hardened droplets on the lip of the bottle which prevent proper seating of the bottle cap causing leakage. Furthermore, any coating on the lip of the bottle is undesirable since the lip surface sometimes is poorly treated and coating can become loosened in the course of uncapping the bottle.

The wiper is located in the drying oven **67** at a point where dripping has stopped, and the last few drops of draining coating hang from the lip. The wiper is located between two adjacent ventilating jets **67**. Wiping is done while the conveyor is moving the bottle from one air jet to the next.

The wiper consists of a cup **64** into which is cemented a disk of open cell resilient, urethane foam. A manifold **66** feeds solvent such as water into the base of cup **64**. Solvent diffuses upward through the foam and flows out through the surface, overflowing into a larger cup **68**. From here the water flows through an outlet tube **70** into wash-water sump **72** provided with a recycle pump **74** for solvent feed line **76**.

The bottle lip passes over the surface of the flooded foam. Rubbing action of the foam removes partly dried coating which is flushed away by the water. Thus our wiper is self cleaning.

After passing over the flooded foam the bottle lip is dripping with water containing a very small amount of coating residue. This is removed by passing through a second or dry wiper **78**. This is merely a slab of urethane foam set in a metal support. Th dry wiper actually remains moist and pliable from water carried over from the flooded wiper. This prevents drying out and crusting over, which destroys wiping action.

FIG. 5 shows a filler tube **50** of FIG. 4 in greater detail with a bottle positioned beneath it. The tube is close enough to the bottle mouth to effect injection of coating fluid into the bottle while being clear of the bottle to permit its passage.

FIG. 6 illustrates the control-scheme to effect operation of the coating machine as depicted in FIG. 4. The closing of line switch SW–4 and safety switch SW–3 energizes movement of the conveyor until cross-bar **54** depresses limit switch **56** thus activating timer **58**. Contacts in timer **58** open during a timing and timed out cycle causing clutch-brake controller CBC to deenergize the clutch C and simultaneously activate the brake B, thereby stopping or indexing the conveyor. A motor, M, which provides the mechanical drive for the conveyor remains running throughout the entire cycle. During the timing sequences, timer **58** supplies current to close solenoid relay R–1 and to open solenoid valve SVA which feeds air to the ventillating air manifold. When relay R–1 closes it activates timer **60**. While timing, timer **60** supplies current to six solenoid valves SVC–1, –2, –3, –4, –5, and –6, supplying fluid to the filler tubes **50**. When timer **60** times out, it supplies current to solenoid relay R–2 which allows timer **58** to reset after a one-half second time delay on deenergization.

Toggle switches SWC–1, –2, –3, –4, –5, and –6 permit individual solenoid valves to be manually shut off.

Push button PB permits manual start of the timer cycle from the control panel.

Toggle switch SW–2, when open, permits continuous conveyor movement without indexing.

Toggle switch SW–5 allows the clutch to be deenergized independently, thereby allowing the machine to be put through the bottle-fill cycle without conveyor movement.

What is claimed is:

1. Method of coating bottles, which comprises holding the bottles by the outside edge of the neck thereof, conveying the bottles in suspended relation through an arcuate path at a coating station first down to receive coating solution and then up to drain solution therefrom, then in an inverted position through a drying station where the bottle is heated.

2. Method as claimed in claim **1**, in which the bottle being conveyed down in said arcuate path is submerged in the coating solution to fill the interior thereof, and the

interior is drained as the bottle is conveyed up in said arcuate path.

3. Method as claimed in claim 1, in which the bottle after being conveyed up in said arcuate path is then passed along an inclined path in which the bottle with the neck down is at an acute angle to the horizontal.

4. Method as claimed in claim 1, in which the interior of the bottle being heated in said drying station is subjected to an air jet purge.

5. Apparatus for coating bottles, which comprises means for holding the bottles by the outside edge of the neck thereof, means for conveying the bottles in suspended relation through an arcuate path at a coating station first down to receive coating solution and then up to drain solution therefrom, then in an inverted position through a drying station where the bottle is heated.

6. Apparatus as claimed in claim 5, in combination with a tank containing coating solution in which the bottle being conveyed down in said arcuate path is submerged to fill the interior thereof, and from which the filled bottle emerges and drains as the bottle is conveyed up in said arcuate path.

7. Apparatus as claimed in claim 5, in combination with means for passing the bottle from said arcuate path upwardly along an inclined path in which the bottle with the neck down is inclined at an acute angle to the horizontal.

8. Apparatus as claimed in claim 5, in combination with an air jet in said drying station for subjecting the interior of the bottle being heated to a purging operation.

9. Method of coating bottles, which comprises holding the bottles by the outside edge of the neck thereof, conveying the held bottles to a filling station in suspended relation to receive coating solution, inverting the coated bottles while conveying them in a draining station to discharge excess coating solution, conveying the discharged bottles through a drying station, and heating the conveyed bottles in said drying station.

10. Method as claimed in claim 9, in which the coating solution is pumped through the so held necks of said bottles into the interior thereof at said filling station in sufficient quantity to fill the bottom portion of the bottle, and to coat the remaining upper portion of the bottle as the excess is discharged at said draining station.

11. Method as claimed in claim 9 in which the necks of the inverted discharged bottles are passed over a porous wiper containing solvent for said coating before the bottles leave said drying station.

12. Method of coating bottles, which comprises feeding the bottles into engagement of the outside edge of the neck thereof with a holder, conveying said holder with the bottle suspended therebelow to a filling station to receive coating solution, conveying said holders to a draining station along an arcuate path with the necks of the bottles toward the center of curvature and thereby inverting said bottles to discharge excess coating solution, conveying the discharged bottles through a drying station, and heating the conveyed bottles in said drying station.

13. Apparatus for coating bottles, which comprises means for holding the bottles by the outside edge of the neck thereof, means for conveying the held bottles to a filling station in suspended relation to receive coating solution, means for inverting the coated bottles while conveying them in a draining station to discharge excess coating solution, means for conveying the discharged bottles through a drying station, and an oven at said drying station for heating the conveyed bottles.

14. Apparatus as claimed in claim 13 in combination with a porous wiper containing solvent for said coating and engaging the necks of the inverted discharged bottles before they leave said drying oven.

15. Apparatus as claimed in claim 13 in combination with a pump and filler tubes in the filling station adapted for pumping coating solution into the interior of the bottles.

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