ABSTRACT: Precooled uncarbonated beverage is filled into an open topped container. A slug of solid carbon dioxide is deposited into the container while the beverage temperature is still near its freezing point causing the solid carbon dioxide to be encapsulated by a film of ice formed by the beverage. The film acts to control the rate of sublimation of the solid carbon dioxide. The containers are sealed and agitated. Means are also disclosed to provide the sized slugs of solid carbon dioxide.
3,607,303 BEVERAGE CARBONATION METHODS AND APPARATUS

My invention relates to the carbonating of beverages in individual, sealed containers having a destructible closure, where a syrup-water mixture is first cooled to near freezing and where a known quantity of solid carbon dioxide is deposited in the cooled mixture of each container just before permanent sealing of the container.

In the soda pop industry, the demand for canned and bottled soda pop is rising by about 300 percent per year. The present conventional production facilities cannot keep up with this demand because of inherent limitations related to the rate of production. It is extremely expensive and often economically prohibitive to install new facilities because construction of each such facility presently costs in the neighborhood of three-quarters of $1 million. More specifically, soda pop is presently being carbonated with liquid carbon dioxide and necessitates carbonating the beverage before filling the containers. Using this technique, it is quite difficult to attain the exact carbonation required for a given beverage. Once carbonated, the beverage will foam with agitation. Therefore, beverage turbulence must be held within suitable limits when containers are filled, which materially restricts the rate at which containers may be filled. Also, in order to achieve an acceptable reaction between gaseous carbon dioxide and water, the gaseous carbon dioxide in solution must be in equilibrium with gaseous carbon dioxide in the surrounding atmosphere. Special devices are required to provide such a surrounding atmosphere. To the contrary, when one places an empty container in a normal atmosphere free of gaseous carbon dioxide, with slight agitation during deposition of carbonated beverage in the container a magnitude of foaming will occur resulting in the container becoming filled with less than the required ounces of liquid per container. These nearly filled containers, not being satisfactory for commercial distribution, would ordinarily be destroyed. For the foregoing reasons, manufacturers of soda pop have found it impossible using conventional equipment and procedures to fill more than about 500 12-ounce cans per minute with a 50-spout filler.

The solution I have found to the problem of the mentioned limited production rate is to carbonate, after the beverage has been placed in a container in an uncarbonated state, with a selected quantity of solid carbon dioxide at a point in time just preceding the sealing of each container. This approach substantially eliminates foaming and thereby allows for a much faster rate of filling containers under pressure.

Accordingly, a primary object of this invention is to provide a novel method and unique apparatus for bottling or canning carbonated beverages at a rapid rate not attainable using conventional equipment and procedures.

Another significant object of this invention is to provide a novel apparatus for carbonating beverages with solid carbon dioxide.

Another important object of this invention is the provision of a novel method for carbonating a beverage in commercial, vendable containers using solid carbon dioxide.

These and other objects and features of the present invention will become more fully apparent from the following description and appended claims taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic representation in perspective of the presently preferred apparatus according to this invention for carbonating beverage;

FIG. 2 is a longitudinal schematic side elevation in cross section of one presently preferred dry ice extruder with the cutter mechanism shown fragmentarily;

FIG. 3 is a schematic fragmentary front elevation of the cutter mechanism of FIG. 2 with a part broken away for clarity of illustration;

FIG. 4 is a schematic fragmentary side elevation in cross section of the cutter mechanism taken along line 4—4 of FIG. 3;

FIG. 5 is a longitudinal schematic side elevation in cross section of a section presently preferred dry ice extruder also with the cutter mechanism shown fragmentarily;

FIG. 6 is a fragmentary perspective representation of another apparatus comprising several cutting devices for sizing small chunks of solid carbon dioxide from a large block of dry ice;

FIG. 7 is a side elevation in cross section of a hermetically sealed can of soda pop in which a lump of dry ice is slowly sublimating;

FIG. 8 is a side elevation in cross section of a bottle of soda pop yet to be hermetically sealed in which a lump of slowly sublimating dry ice has been deposited from an elevated screw-ram extruder;

FIG. 9 is a schematic side cross-sectional elevation of one filler valve which can be used with the present invention.

Specific reference is made to the drawings to describe my presently preferred carbonating system, the operation of which is, hereafter, related to a 50-spout filler, converted for use with the present invention.

When compared with conventional liquid CO₂ carbonating apparatus, the present preferred apparatus is not equipped with liquid CO₂ injection and a CO₂ atmosphere is not maintained in a carbo-cooler.

Initially, with reference to the diagrammatic representation of FIG. 1, air or gas-free syrup is stored and preferably precooled in tank 10 and degassed water is stored and preferably precooled in tank 12. Tank 10, for example only, may be the mixing tank 6511V1532 distributed by Potter and Royfield, of Atlanta, Ga. Tank 12, for example only, may be a water treating facility such as the Western Recirculator Time Treating System, model number 340-RFB, distributed by Western Filter Company of Denver, Colo. or a distributor distributed as catalog number DA 993 by George J. Meyer Company of Cudahy, Wis.

Syrup and water from tanks 10 and 12 in predetermined ratio, according to the given beverage under production, are mixed one with the other with a synchronizer 14, such as unit DA 994 manufactured by the mentioned George J. Meyer Company.

After mixing and without carbonation, the syrup-water mixture is refrigerated in a cooler, diagrammatically illustrated as numeral 16 in FIG. 1, under a comparatively high pressure, such as 90 p.s.i. No CO₂ is present in cooler 16. Otherwise, carbo-cooler Model 36-60 No. 4787, manufactured by Mojonnier Bros. of 4601 West Ohio Street, Chicago, III., would be suitable for use as the cooler 16, as long as the CO₂ intake was valves off and the pressure upon the liquid was sufficiently elevated. By use of pressure cooler 16, the temperature of the syrup-water mixture is lowered to just slightly above freezing. In addition to producing the pressure and temperature required, cooler 16 must keep the syrup-water mixture free of foreign matter, including air.

After being cooled to near freezing a closely controlled amount of the syrup-water mixture is rapidly ejected from the cooler 16 into open individual containers, such as cans 18 (FIG. 1 and 7), under the pressure of cooler 16 through a filler 20. The filler 20 preferably utilizes a pressurized filler valve and differs from a standard gravity-flow filler, such as the Meyer Dunmore 50-Spout filler HP 156 manufactured by George J. Meyer Company, primarily in that rapid high pressure filling is achieved.

Presently, on a 50-spout filler, of the Meyer Dunmor type, there are 35 available filler valves at any one time. Each of these valves has a three-fourths inch inside diameter making the effective fill opening less than three-fourths inch. Through experimentation it was found that using prior art techniques, the time required to fill a 12-ounce can at the conventional 0 p.s.i.g. pressure without unacceptable foaming was about 4 seconds. The fill time for a 12-ounce can through the same size fill opening using the present invention and a pressure of 90 p.s.i. was about 0.75 of 1 second. Thus, the maximum conventional filling speed on a 50-spout filler with gravity flow is 525 cans per minute, while the maximum fill speed using this invention is 2,800 cans per minute. The increase from 525 cans per minute to 2,800 cans per minute on a 5-day week, 8-hour day basis would mean an increase of about 40,000 cases
per week to about 280,000 cases per week. This would mean that with generally the same overhead one could with nearly the same plant produce seven times as much product using this invention. Figured at an estimated 15 per case profit for everything over 40,000 cases per week, that would mean an additional $36,000 profit per week. Of course, for the higher rates of production a greater cooling capability at cooler 16 would be needed.

One suitable filler valve, generally designated 170, is illustrated in FIG. 9. The valve 170 is normally surrounded by the uncarbonated syrup-water liquid under relatively high pressure within a bowl 172. An air-evacuation tube 174 depends beneath the head 176 of the valve and extends upward beyond the bowl 172. During operation, a container, e.g. can 18, is elevated by a conventional apparatus until the lip 178 at the open end of the can 18 is sealed against an elasmonic annulus 180, which is embodied in the heat 176.

Such placement of the can 18 causes solenoid 182 to be energized, thus lifting the tube 174 as well as piston 184 and tapered rubber or like stopper 186. Elevating of the stopper from seat 188 of housing 190 a suitable distance will open side ports 192 in housing 190, allowing syrup-water liquid to flow under the high pressure into the can 18. Air in the can escaped through the tube 174.

When the can 18 is nearly full with the liquid level above the lower end of tube 174 air will be temporarily trapped in the hollow of the head 176 and housing 190. This will cause liquid to rise within the tube 174, close the sensor 194 and deenergize the solenoid 182. Instantly, the spring 196 will return tube 174, piston 184 and stopper 186 downward, closing the ports 192 and causing stopper 186 to seat at 188. The sensor 194, comprising leads 198 and 199, may be liquid sensor relay No. R7089A distributed by Honeywell, Inc. of Minneapolis, Minn.

Lowering of the can 18 will release the trapped air and leave the liquid level in the can below the edge 178 sufficient to accommodate a predetermined quantity of dry ice and with no more than the standard amount of space remaining at the top of the container following sealing of the container.

The cans 18 are diagrammatically shown as being spaced along and delivered to the filler 20 by a suitably powered conveyor 22. In the beginning each can, container or vessel is closed at the lower end only and is adapted to be sealed on one end by the closing machine, e.g., a bottle cap, "pop-top", or regular lid which is destroyed when the sealed container is opened. Once a container has been filled with the prescribed amount of syrup-water solution and the solution is near freezing temperature, a known quantity of solid carbon dioxide 26, preferably in one slug, is deposited in the container, for example, using a solid CO2 ejection 24 (FIG. 1).

The volume of CO2 placed in a container will vary depending on the density thereof and the amount of carbonation specified for the particular type of soda pop being produced. The weight of solid CO2 needed to carbonate a 12-ounce container of syrup-water mixture will, according to my experimentation normally fall within the range of about 0.5 to 2.0 grams in order to provide the 1.5 to 4.2 volumes of sublimated gaseous CO2 for standard carbonation, as specified by various companies for soft drink products. By definition, one volume is the gas required to fill a container at normal atmospheric temperature and pressure.

Once deposited, the chunk or slug 26 of dry ice will be enveloped in a shell of ice consisting of a frozen film of syrup-water mixture, because of its near freezing temperatures, as the slug 26 sinks to the bottom of the container, being heavier than syrup-water mixture.

While any one of a number of solid CO2 ejectors could be used to periodically provide correctly sized solid CO2 slugs for the mentioned purpose, only four, designated by numerals 30 (FIGS. 2-4), 32 (FIG. 5), 34 (FIG. 6) and 36 (FIG. 8) have been herein diagrammatically depicted and will now be described.

Extruder 30, shown in FIGS. 2-4, comprises an outer casing 33 (FIG. 2) consisting of a large diameter cylindrical back portion 35 with a side ingress port 37 for receiving dry ice, a central tapered portion 38 and a small diameter cylindrical extrusion nozzle 40 which terminates in an egress port 42. A ram plate 44 reciprocates within the cylindrical portion 34 by power action of piston rod 46. This consolidates the dry ice as it is displaced through the tapered portion 38 and forces a dense cylinder of dry ice out the port 42 where it is cut into segments by a reciprocating cutting blade 48.

The blade 48 is shown as being powered by a rotated shaft 50 and lug 52, nonrotatably fastened to the end of the shaft 50 by setscrews 54 or the like. A fastener 56 is screwed in a threaded bore 58 and rotatably passes through a bushing 60 in a cutter drive rod 62. The rod 62 is joined to the cutter blade 48 by a rivet 64 flanked by serially disposed bushings 66 and 68. Thus, as the shaft 50 rotates, the rod 62 and blade 48 will correspondingly reciprocate to cut the dry ice being extruded from the nozzle port 42 into appropriately sized slugs.

The movement of the blade 48 may be channeled by use of a member 70 having U-shaped edge guides 72 shaped and sized to assure linear to and fro periodic displacement of the blade 48 across the port 42.

The extruder 32 (FIG. 5) operates to the same end as extruder 30 and comprises an open receiving chamber 80 in which large pieces of dry ice are deposited, and one or more shredding blades 82 are carried by a power driven rotating shaft 84. Shredded dry ice falls by force of gravity into a hopper 86 which feeds the shredded dry ice through an ingress port 88 into an extrusion barrel 90. The barrel 90 is shown as being shaped much like the casing 33 of extruder 30.

However, dry ice within the barrel 90 is compacted and displaced by a tapered auger or screw 92, provided with a helical vane. The auger or screw 92 is rotated by a power shaft 94 which turns in a bushing 96. The same cutter blade 48 and related drive mechanism may be used to cut the compacted and extruded length of dry ice into segments.

Extrusion is not mandatory. For example, a large block of dry ice may be satisfactorily subdivided by hand or mechanically for placement in the container of syrup-water mixture. For example, with reference to FIG. 6, a large block 100 of solid CO2 may be cut into slabs 101 by use of a power reciprocated box 102 and power operated cutting band 104. Reciprocating cutting blades 106 and knife edge 108 divide the slab into rectangular cubes or chunks 110 for placement in containers. The chunks 110 are shown as being carried to the solid CO2 ejector station by a power screw 112.

Where it is desired to eliminate the cutter blade and related drive mechanism the extruder 36 of FIG. 8 may be resorted to. Dry ice, preferably in flake or equivalent form, is fed into the top end (not shown) of extrusion barrel 120. Barrel 120 is also shaped similar to casing 33 of extruder 30. Once the rotating screw-ram 122 has compacted the solid CO2 and filled the nozzle 124, the screw-ram is advanced causing the plunger rod 126 to purge the dry ice from the nozzle 124 (see the position in FIG. 8). The resulting slug 128 will be deposited in the waiting container. The container in FIG. 8 is shown to be a bottle 130 filled with uncarbonated syrup-water mixture.

Long term storage prior to use of correctly sized slugs or chunks of solid CO2 is not advisable because inherent sublimation of solid to gaseous CO2 will alter the quantity of each slug or chunk so that later use will not achieve the proper level of carbonation. Thus, deposition of each slug or chunk of dry ice in a container promptly following fabrication is recommended.

It is important that the open end of each container be sealed promptly following sublimation of the solid carbon dioxide therein and that the temperature of the syrup-water mixture be established and maintained for a period of time at near freezing following deposition of the solid carbon dioxide. In this way, the mentioned shell of ice encapsulating the solid CO2 in the container is maintained. The shelf of ice allows the enclosed solid CO2 to sublime at a relatively slow rate which
will not exceed the rate at which the resulting gaseous CO₂ is dissolved by syrup-water mixture through chemical reaction. Thus, when proper agitation is also provided, no rupture or deformation damage to the container will occur. It has been found that if the shell of ice is not maintained, the solid CO₂ will sublimate faster than it can go 4 per with the syrup-water mixture and will cause damage to the sealed container as a result of the high internal pressures which are so developed. The exposed surface area of the solid CO₂ in the container must also be limited in order that CO₂ sublimation not exceed CO₂ dissolution; the use of a single slug of CO₂ is preferred.

A cost savings will accrue by use of solid CO₂ in the manner mentioned. At the present time, solid CO₂ costs approximately 4 per pound; based upon a 5-day week, 8-hour days, and a twenty-eight hundred can per minute production rate, about 14,800 pounds of solid CO₂ would be used per week, at a cost of...

Also, a conventional undercooler-gasser is to be used for replacing air at the top of the container with CO₂ gas. The CO₂ estimated to be used with the present invention by the undercooler-gasser would cost about $200.00 per week under the mentioned use conditions. Thus, the present system would cost approximately 28 per case to carbonate soft drinks at the production rate indicated as opposed to approximately 1 per case when present conventional carbonating methods are used. Hence, the net savings would be approximately $2,000.00 per week in CO₂ cost alone.

As mentioned, each container is desirably permanently sealed promptly after insertion of the proper quantity of the solid CO₂. The slow rate of sublimation of the solid CO₂ 140 (FIG. 7) and 128 (FIG. 8) to gaseous CO₂ through the film of syrup-water ice 142 and 144, respectively, is illustrated as a single stream 146 and 148 of gaseous CO₂.

The upper closure 150 of the can 18 (FIG. 7) and the bottle cap 152 (shown in dotted lines in FIG. 8) are placed in sealed relation at one end of the can 18 and the bottle 130, respectively, using conventional technology.

With reference once again to FIG. 1, one suitable seamer for placing a closure of the type designated by numeral 150 is diagrammatically illustrated and generally identified by the numeral 160. The seamer 160 is conventional and may comprise seam 490-HCM-1 manufactured by the Continental Can Company of 633 Third Avenue, New York, New York. As mentioned, the seamer would comprise a conventional undercooler-gasser for replacing air at the top of each container with CO₂ gas.

After inserting the solid CO₂ in a container and conventionally sealing the container, the container must be tumbled, vibrated or agitated in a device 162 (FIG. 1), called a can warmer, causing frequent inversion of the container, for a known period of time under controlled temperature conditions to allow for a mixing of the gaseous CO₂ 146 and 148 (FIGS. 7 and 8) within the syrup-water mixture for even distribution and dissolution. One suitable device for so tumbling or vibrations the sealed containers comprises can warmer FMC 55" E-1491 manufactured by Food Machinery and Chemical Corporation of San Jose, Calif.

After each container has been suitably vibrated or tumbled in the manner indicated, it is normally delivered to a packaging station 164 (FIG. 1) where the containers are packaged appropriately for shipment and ultimate distribution to the consumer.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims which come within the meaning and range of equivalency of the claims are therefore to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. Method of carbonating a beverage comprising precooling a liquid beverage to near its freezing point, separately depositing a controlled quantity of solid carbon dioxide and a volume of the liquid beverage within a can or bottle used for commercial vending of carbonated beverages to consumers while the temperature of the liquid is still near freezing thereby causing the solid carbon dioxide to be encapsulated in a film of ice formed by the beverage along the exposed peripheral surfaces of the solid carbon dioxide and slowly sublimating gaseous carbon dioxide from the solid carbon dioxide through the film of beverage ice into the liquid beverage at a rate not exceeding the rate at which gaseous carbon dioxide is absorbed by the liquid beverage.

2. Method according to claim 1 further comprising a fabricating step which comprises providing a per unit quantity of solid carbon dioxide not less than about one-half grams per 12-ounce container and said depositing step comprises placing substantially the identical amount of solid carbon dioxide in each container.

3. Method of continuously mass filling and sealing vessels comprising only cans or bottles used in the commercial distribution of carbonated beverages: cooling uncarbonated liquid beverage to a temperature slightly above freezing, filling at a filling station a predetermined amount of uncarbonated liquid beverage into one vessel after another through an open upper end thereof under a relatively high pressure and at a rate which would excessively foam a carbonated liquid thereby filling a significantly greater number of vessels per unit of time, depositing at a separate carbonation station a predetermined amount of solid carbon dioxide in each vessel while the temperature of the liquid in said vessel is still near freezing thereby causing beverage to freeze adjacent each piece of solid carbon dioxide and encapsulate each piece of solid carbon dioxide in a sheath of ice, and promptly thereafter sealing at a separate sealing station the upper end of each vessel with fluid tight through destructible closure comprising a cap or lid of sheet material at said end, controlling the rate of sublimation of the deposited carbon dioxide from solid to gaseous state by the confinement afforded by the sheath of ice, controlling the distribution of dissolution in the liquid beverage of sublimed carbon dioxide to avoid pressure damage to the vessels by tumbling each vessel at a separate tumbling station for a period of time.

4. Method of filling containers with a soft drink for commercial vending: cooling the liquid to a temperature just slightly above the freezing point, successively filling commercial cans or glass bottles with the liquid, carbonating the contained liquid by addition of a known volume of solid carbon dioxide into the commercial cans or glass bottles through a top open and thereof while the temperature of the liquid is near freezing causing the solid carbon dioxide in each can or bottle to be encapsulated in an ice shell, and immediately thereafter sealing the liquid and solid carbon dioxide within each can or bottle by placing a destructible commercial cap or lid in sealed relation over the top open end and thereafter submerging the carbon dioxide from solid to gaseous state in each can or bottle through the ice shell at substantially the rate at which the gaseous carbon dioxide is absorbed by the liquid.

5. Method as defined in claim 4 wherein the solid carbon dioxide is added to the cooled liquid of each can or bottle in the form of a single slug.

6. Method as defined in claim 4 further comprising the step of tumbling each container under controlled temperature conditions following sealing of the container.

7. Method of mass filling containers, used to commercially distribute carbonated soft drinks consisting of cans and bottles with a carbonated soft drink, the steps of: precooling syrup-water mixture to near freezing; successively feeding the cans or bottles, each having an open top end, to a filling station; supplying the precooled syrup-water mixture to the filling station;
Substantially filling the cans or bottles seriatim with the precooled syrup-water mixture through the opening at the top of each can or bottle; sequentially depositing a predetermined quantity of solid carbon dioxide in the cans or bottles through the top opening thereof; contacting the precooled mixture with the deposited quantity of solid carbon dioxide thereby causing a layer of the mixture to freeze about and encapsulate the deposited solid carbon dioxide; sealing the top opening of the cans or bottles containing solid carbon dioxide and mixture with a destructible cap or lid comprising sheet material; preventing the creation of elevated pressures in each sealed can or bottle by sublimating gaseous carbon dioxide into the mixture through the frozen layer at a greatly reduced rate not substantially greater than the rate of absorption of gaseous carbon dioxide by the mixture whereby the cans or bottles and caps or lids thereof are not damaged by internal pressure.

8. Method of producing carbonated beverage in a sealed container, comprising:
precooling a water-syrup mixture to near freezing;
filling the thus precooled mixture into an open top container under relatively high pressure;
adding to the mixture in the container a predetermined amount of solid CO₂ thereby causing an ice sheath to form around the solid CO₂;
promptly sealing the container;
establishing and maintaining the temperature of the contents of the container sufficiently low so as to maintain the ice sheath around the solid CO₂ for a period of time to control the rate of sublimation at substantially the rate at which the gaseous CO₂ is absorbed; and tumbling the container under controlled temperature conditions.

9. A system for filling commercial cans and bottles with a carbonated beverage for commercial vending comprising in combination:
means for providing a plurality of open cans or bottles;
conveyor means upon which the open cans or bottles are carried in succession from the providing means to a filling station;
means at the filling station aligned with the conveyor means for serially filling each open can or bottle with a proportioned syrup-water mixture;
means providing the syrup-water mixture at a temperature only slightly above the freezing point of the mixture;
means selectively delivering the syrup-water mixture from the syrup-water providing means to the filling means;
means comprising a source of units of solid carbon dioxide, said units being of predetermined quantity;
means disposed vertically above the conveyor means with which the opening of each can or bottle become vertically aligned, said last-mentioned means being in communication with the source means, for successively depositing a unit of solid carbon dioxide in each open can or bottle;
means for successively affixing a destructible cap or lid of sheet material in sealed relation over the opening in each can or bottle promptly following the deposition of a unit of solid carbon dioxide therein.

10. A system as defined in claim 9 wherein said filling means further comprises pressure developing means acting upon the mixture to markedly increase the rate at which the mixture is transferred to the can or bottles.

11. A system according to claim 9 wherein said source means comprises an extruder for sizing small chunks of solid carbon dioxide from a much larger supply of solid carbon dioxide.

12. A system according to claim 11 wherein the extruder has a small diameter extrusion nozzle and the extruder comprises a cutter periodically reciprocated to sever a length of dry ice extruded from the nozzle.

13. A system according to claim 9 wherein said source means comprises a plurality of cutting means for subdividing a large volume of solid carbon dioxide.
UNIVERSAL FLAT-BED MATERIAL HANDLING APPARATUS

Patent No. 3,607,303 Dated September 21, 1971

Inventor(s): Joseph P. Bingham

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 8, "dies" should read --side--.

Column 2, line 44, "as" (second occurrence) should read --so--.

Column 2, line 57, "Dunmore" should read --Dunmor--.

Column 3, line 4, after "15" insert --a--.

Column 3, line 17, "heat" should read --head--.

Column 3, line 25, "cam" should read --can--.

Column 4, line 57, "waiting" should read --awaiting--.

Column 5, line 6, "go 4 per" should read --go into combination--.

Column 5, line 15, after "4" insert --a--.

Column 5, line 24, after "28" insert --a--.

Column 5, line 25, after "1" insert --a--.

Column 5, line 28, "cost" should read --costs--.

Column 5, line 44, "seam" should read --seamer--.

Column 6, line 23, "freezing" should read --freezing--.

Column 6, line 70, "steps" should read --steps--.

Column 8, line 16, "become" should read --becomes--.

Signed and sealed this 25th day of April 1972.

(Seal)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCALK
Commissioner of Patents