METHOD AND APPARATUS FOR APPLYING A COATING
TO THE INTERIOR SURFACE OF A
HOLLOW ARTICLE

Filed May 20, 1965

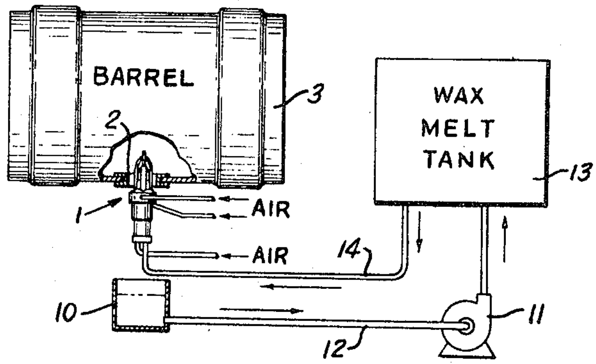

Fig. 1.

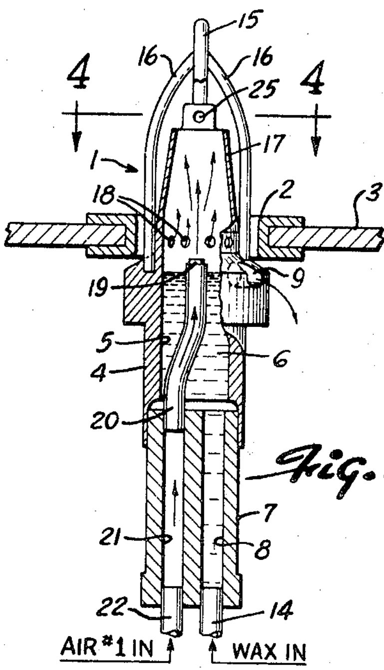

Fig. 3.

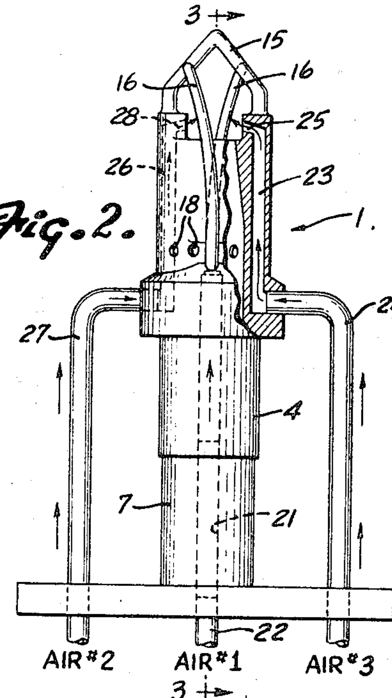

Fig. 2.

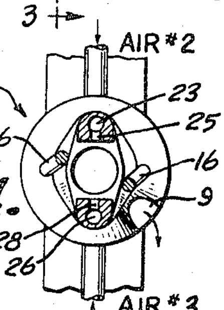

Fig. 4.

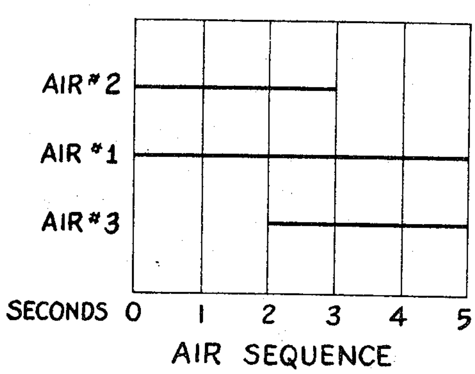

Fig. 5.

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United States Patent Office 3,488,213
Patented Jan. 6, 1970

3,488,213

METHOD AND APPARATUS FOR APPLYING A COATING TO THE INTERIOR SURFACE OF A HOLLOW ARTICLE

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Filed May 20, 1965, Ser. No. 457,264
Int. Cl. B05b *1/00, 13/06;* B05c *7/02*
U.S. Cl. 117—96 11 Claims

ABSTRACT OF THE DISCLOSURE

A method and nozzle assembly for coating the interior surface of a barrel with wax or other coating material The nozzle assembly is adapted to be inserted within the bunghole of the barrel and includes a central reservoir which contains melted wax. The wax is continuously pumped to the reservoir and overflows from the reservoir so that a continual flow of melted wax is achieved. The melted wax is atomized by a pressurized stream of air which is ejected through an orifice into a discharge nozzle located above the level of the wax. In addition to the primary air stream, a pair of auxiliary air jets are employed which are directed laterally towards the ends of the barrel and the auxiliary jets aid in atomizing the wax and directing the atomized wax towards the ends of the barrel.

This invention relates to a method and apparatus for applying a coating to the interior surface of a hollow article and more particularly to a method and apparatus for applying wax or similar coatings to the interior of beer barrels.

Beer barrels are generally made of aluminum alloys and it has been found that the aluminum may adversely affect the taste characteristics of the beer. In view of this, a protective coating is normally applied to the interior surface of the barrel before filling. In the past a coating of pitch was generally used as the protective coating. However, pitch is rather difficult to apply to the interior surface of the barrel and is not easily removed prior to refilling. More recently, wax coatings have been used on the interior of aluminum barrels for the wax coating is less costly and can be more easily removed by washing with heated water or steam.

The present invention is directed to a nozzle assembly for coating the interior surface of the barrel with wax or other similar coatings. The nozzle assembly is adapted to be inserted within the bunghole of the barrel or keg and includes a central reservoir which contains melted wax. The melted wax is continuously pumped to the reservoir and overflows into a trough where it is returned to the melting tank so that a continual flow of melted wax is achieved. The melted wax is atomized by a pressurized stream of air which is ejected through an orifice into a discharge nozzle located above the level of the wax. The decrease in pressure brought about by ejecting the air serves to atomize the wax and provide a cloud or fog of small wax particles within the barrel. In addition to the primary air stream, a pair of auxiliary air jets are employed which are directed laterally toward the ends of the barrel, and the auxiliary air jets also aid in atomizing the wax and direct the atomized cloud toward the ends of the barrel.

In the process of the invention, the keg is heated to a temperature above the melting point of the wax while the wax is maintained at a temperature above its melting point and below its boiling point. In addition to heating the keg, the air which is introduced into the nozzle assembly is also heated to a temperature at or above the keg temperature.

In operation, the nozzle assembly is introduced into the bunghole of the heated keg and the air is introduced through the central jet for a period of about 5 seconds to atomize the melted wax and produce a cloud or fog of atomized wax articles in the barrel. The atomized particles adhere to the surface of the heated keg and spread out in the form of a thin uniform film.

Air is also introduced through the auxiliary jets in timed sequence with the main or central jet so that the atomized particles are deflected toward the ends of the barrel to completely coat both ends of the barrel. The volume of air introduced through the main and auxiliary jets during the atomizing sequence is greater than the volume of the keg so that the air will tend to flow out of the bunghole through the space surrounding the nozzle assembly and this insures that the area around the bung will be completely coated with the wax.

The use of the invention provides complete wax coverage for the entire internal surface of the keg, including the area adjacent the bung.

The coating produced by the atomization process is thin and uniform, without voids, and can easily be removed prior to refilling by heated water or steam. The entire coating process can be completed in a period of about 5 seconds, making the process particularly adaptable to assembly line operation.

Other objects and advantages will appear in the course of the following description.

The drawings illustrate the best mode presently contemplated of carrying out the invention.

In the drawings:

FIG. 1 is a schematic representation of the nozzle assembly and wax melting tank as associated with a key to be coated;

FIG. 2 is a side elevation of the nozzle assembly with parts broken away in section;

FIG. 3 is a vertical section taken along line 3—3 of FIG. 2 showing the nozzle assembly;

FIG. 4 is a transverse section taken along line 4—4 of FIG. 3; and

FIG. 5 is a graph showing the squence of air supplied to the nozzle assembly.

The drawings illustrate an atomizing nozzle assembly **1** which is adapted to be inserted within the bung **2** of a key or barrel **3** to coat the interior surface of the keg with wax or other protective coating. While paraffin wax is the preferred coating material other materials such as thermoplastic resins, pitch and the like can also be used.

As best shown in FIGS. 2–4, the nozzle assembly includes an outer casing **4** which defines a reservoir **5** containing a supply of liquid wax **6**. A fitting **7** is secured within the lower end of the casing **4** and liquid wax is supplied to the reservoir **5** through a passage **8** in fitting **7**.

To maintain a constant level of wax in the reservoir **5**, an overflow outlet **9** is provided in the casing and excess wax flows through the overflow outlet **9** and is collected in a trough **10** shown diagrammatically in FIG. 1. The wax is pumped from trough **10** by a pump **11** through a line **12** to a wax melting tank **13** and the heated liquid wax is returned to the nozzle assembly through line **14** which is connected to the passage **8**. With this flow system, the wax is continuously supplied to the reservoir **5** and the excess wax is returned to the melting tank **13** to provide a predetermined quantity of wax in reservoir **5** at a substantially uniform temperature.

To aid in centering the nozzle assembly **1** within the bung **2** of keg **3**, a U-shaped locater wire **15** extends outwardly from the upper end of casing **4**, and, in addition, a pair of guide wires **16** is positioned approximately 90° from wire **15** and are connected between the casing and the upper portion of the locater wire **15**. The upper ends of guide wires **16** are bent or curved in opposite directions from the center line of the nozzle, as shown in FIG. 2.

A tapered discharge nozzle **17** is mounted in the upper end of the casing and communicates with the wax reservoir **5**. A series of air holes **18** is provided in the lower portion of the nozzle **17** and as pressurized air is discharged through the nozzle **17** secondary air is drawn into the nozzle through the openings **18**.

The wax within the reservoir **5** is atomized by air discharged from a jet **19** into the tapered nozzle **17**. The jet **19** is located above the overflow outlet **9** so that the jet will be above liquid level. Air under pressure is supplied to jet **19** through a tube **20** which communicates with an air inlet passage **21** formed in the fitting **7** and the lower end of the passage **21** is connected by a tube or hose **22** to a suitable source of air under pressure. The air being discharged through jet **19** and nozzle **17** creates an aspirating effect to atomize the liquid wax in reservoir **5** and produce a cloud or fog of minute wax particles which is directed axially from the nozzle and into the keg.

In addition to the air discharged through the jet **19**, air is also discharged angularly from the nozzle assembly to aid in atomizing the wax and to deflect the atomized cloud toward the ends of the keg to coat these areas with wax. To provide this angular air flow, the casing **4** is provided with a vertical passage **23** and an air inlet tube **24** is connected to the lower end of the passage. The upper end of the passage defines a jet or outlet **25** which is disposed at an angle of about 30 to 60° with respect to the horizontal and is directed toward the axis of the nozzle assembly. Similarly, the opposite side of the casing is provided with a second vertical passage **26** and an air inlet tube **27** is connected to the lower end of passage **26**. As in the case of passage **23**, the upper end of passage **26** terminates in an angular outlet or jet **28** which is directed toward the axis of the nozzle assembly. During the sequence of operation, air is introduced continually through jet **19** and is introduced alternately into each of the passages **23** and **26**. The air being discharged from the jets **25** and **28** serves to assist in the atomization of the wax and deflect the atomized wax toward the respective ends of the keg or barrel.

In order to provide a uniform thin coating of wax on the entire interior surface of the keg, certain important temperature considerations are necessary. The wax or other coating material is maintained at a temperature above its melting point and below its boiling point. Paraffin wax is a preferred coating material and has a melting point in the range of 220° to 235° F., depending on the particular type of paraffin wax, and has a boiling point in the range of 280° to 310° F. In the normal operation, the paraffin wax is heated in tank **13** to a temperature of about 300° F. and is maintained in the liquid state in reservoir **5** at a temperature in the range of 235° to 280° F.

It is also important that the keg be heated to a temperature above the melting point and below the boiling point of the wax. For most operations, the keg is heated to a temperature of 5 to 10° above the melting point of the wax.

In addition to heating the keg, the air which is introduced into the nozzle assembly is also heated to a temperature above the melting point of the wax or other coating material and above the keg temperature. The air as it is ejected from the nozzle has a temperature below the boiling point of the wax and generally in the range of 10° to 40° below the boiling point of the wax. In maintaining this air temperature, the chilling effect due to the pressure drop of the air as it is ejected from the orifice or jet, must be taken into consideration. Therefore, it is normally necessary to preheat the air to a temperature above the ultimate desired temperature to compensate for the temperature drop resulting from the pressure drop through the jet or orifice. When using a wax having a melting point of about 225° F. and a boiling point of about 290° F. the keg is normally heated to a temperature of about 235° F., while the wax is maintained in a fluid state at a temperature of 240° F. and the air ejected from the nozzle has a temperature of about 265° F. With these temperatures the atomized wax particles will not agglomerate into globules and will provide the necessary flow on the heated keg to provide a thin uniform coating.

In carrying out the process of the invention, the keg is initially steam heated in order to remove the prior wax coating before recoating with wax. The temperature at which the keg is steam saturated is determined by the area of the surface to be coated and the weight of the keg as well as the amount of residual water left on the surface during the heat saturation cycle. The remaining water is evaporated by vacuum and the vacuum is a direct function of the resultant temperature of the dried keg. Thus, the steam saturation and vacuum drying cycles are correlated to provide a keg temperature above the melting point of the wax to be used in the coating material.

After the keg has been steam saturated and dried, the heated keg is moved onto the nozzle assembly. Air is then blasted into the nozzle assembly in the sequence shown in FIG. 5. According to this sequence, air is blasted continually through the central tube or jet **19** for a period of five seconds and is also blasted through the jet **25** for a period of three seconds and is subsequently blasted through the second angular jet **28** for the last three seconds of the cycle. The discharge of air through the nozzle serves to atomize the quantity of hot liquid wax contained in the reservoir **5** and entrains the wax particles within the keg. The blast of air through jets **25** and **28** deflects the atomized wax toward the ends of the barrel to completely coat these areas. As the surface of the keg is hot, the wax will strike the surface and spread smoothly over the interior surface of the keg to completely coat the surface in a thin uniform layer. As the siphoning or atomization of the wax from the reservoir takes place at a substantially faster rate than the rate at which the wax is supplied to the reservoir, the entire quantity of wax in the reservoir will be depleted in the five second cycle. Thus, the reservoir serves as a metering device and determines the ultimate thickness of the wax coating on the interior surface of the keg.

In order to adequately coat the entire surface of the keg, including that portion of the keg bordering the nozzle assembly, it is necessary that a greater volume of air be introduced or blasted into the keg than the volume of the empty keg itself. This will insure an egress of air from the bunghole in the space surrounding the nozzle assembly and will thereby insure that the area of the keg bordering the bung will be fully coated with wax.

The nozzle assembly of the invention effectively atomizes the liquid wax and distributes the atomized particles over the entire internal surface of the keg including the area of the keg adjacent the bung. The coating of the interior surface of the keg is accomplished by use of a single nozzle and a short cycle of approximately five seconds. Moreover, the coating produced by the atomization process is thin and uniform without voids and can be easily removed from the keg prior to refilling by using either steam or heated water.

What is claimed is:

1. An atomizing nozzle assembly for coating the interior surface of hollow articles with a coating material, comprising a casing adapted to be inserted within the article and defining an open top reservoir to contain a liquid wax, means for continuously supplying liquid wax to said reservoir, overflow means communicating with the reservoir for maintaining a substantially uniform level of liquid wax in the reservoir, a nozzle communicating with the open top of the reservoir, conduit means connected to the casing and having an outlet orifice disposed axially of the casing and located above the level of the overflow outlet, means for supplying gas to the conduit means with the gas being injected through the outlet orifice into the nozzle to thereby atomize the wax and distribute and atomized particles of the wax material on the interior surface of the article, second conduit means associated with the casing and having a second outlet orifice disposed at an angle to the axis of the casing and facing toward said axis, and means for supplying gas to said second conduit means with said being ejected through said second orifice to deflect the atomized particles of wax laterally from the casing.

2. An atomizing nozzle assembly for coating the interior surface of hollow articles with a coating material, comprising a casing adapted to be inserted within the article and defining an open top reservoir to contain a liquid wax, means for continuously supplying liquid wax to said reservoir, overflow means communicating with the reservoir for maintaining a substantially uniform level of liquid wax in the reservoir, a nozzle communicating with the open top of the reservoir, conduit means connected and having an outlet orifice disposed axially of the casing and located above the level of the overflow outlet, means for supplying gas to the conduit means with the gas being injected through the outlet orifice into the nozzle to thereby atomize the wax and distribute and atomized particles of the wax material on the interior surface of the article, second conduit means associated with the casing and having a second outlet orifice disposed at an angle to the axis of the casing and facing toward said axis, means for supplying gas to said second conduit means, third conduit means associated with the casing and having a third outlet orifice disposed at an angle to the axis of the casing and facing toward said axis, said third outlet orifice being located diametrically opposite said second outlet orifice, means for supplying gas to said third conduit means, said gas being discharged through said second and third orifices to thereby deflect the atomized particles laterally of the casing.

3. An atomizing nozzle assembly for coating the interior surface of hollow articles with a coating material comprising an elongated housing defining an open top reservoir to contain liquid wax, heating means separate from the housing for heating wax to provide a supply of liquid wax, means for continuously feeding liquid wax from the heating means to the reservoir, overflow outlet means communicating with the reservoir for maintaining a given level of liquid wax in the reservoir, a discharge nozzle disposed in axial alignment with said housing and located above said overflow outlet means, a jet connected to said housing and disposed between the reservoir and the nozzle and positioned above the level of liquid wax, and means for periodically supplying a sufficient volume of air under pressure to said jet to thereby atomize substantially the entire quantity of liquid wax in the reservoir and distribute the atomized particles of wax on the inner surface of the article.

4. An atomizing nozzle assembly for coating the interior surface of a hollow articles with a coating material, comprising a casing adapted to be inserted within an opening in the article and defining a reservoir to contain a liquid coating material, a tapered discharge nozzle connected to the upper end of the casing and located above the level of liquid within the reservoir, means for maintaining a constant volume of the liquid coating material in the reservoir, and fluid pressure means including a conduit extending through the reservoir and terminating in a discharge outlet disposed above the upper level of liquid in the reservoir, said conduit being connected with a source of fluid under pressure whereby discharge of said fluid from the discharge outlet and through the nozzle acts to atomize the upper surface of liquid coating material in the reservoir and distribute the atomized material onto the interior surface of the article.

5. An atomizing nozzle assembly for coating the interior surface of a hollow article with a coating material, comprising a casing defining a reservoir to contain a liquid coating material, supply means communicating with the lower end of the reservoir for continuously supplying liquid coating material to the reservoir, overflow means communicating with the reservoir at a location above the level of said supply means for maintaining a substantially uniform volume of liquid coating material in the reservoir, and fluid pressure means associated with the casing and including a discharge outlet disposed above the overflow means with the axis of said outlet being generally parallel to the axis of the casing whereby discharge of fluid under pressure through said discharge outlet acts to atomize the upper surface of the liquid coating material in the reservoir and distribute the atomized material on the inner surface of the article.

6. An atomizing nozzle assembly for coating the interior surface of hollow articles with wax, comprising a casing adapted to be inserted within the article and defining an open-top reservoir to contain a liquid wax, heating means for heating the wax to maintain the wax in a liquid condition, supply means communicating with the lower end of the reservoir for continuously supplying liquid wax to said reservoir, overflow means communicating with the reservoir at a level above the supply means for maintaining a substantially uniform level of liquid wax in the reservoir, a tapered nozzle communicating with the open top of the reservoir, conduit means connected to the casing and located above the level of the overflow means, and means for supplying gas to the conduit means with the gas being ejected through the outlet orifice into the nozzle to thereby atomize the upper surface of wax in the reservoir and distribute the atomized particles of the wax on the interior surface of the article.

7. A method of coating the interior surface of a keg with a coating material, comprising the steps of maintaining a substantially constant volume of liquid coating material in a reservoir, maintaining said volume of coating material at a temperature above its melting point and below its boiling point, heating the keg to a temperature above the melting point of the coating material and below the boiling point of said coating material, heating a gas to a temperature above said melting point and below said boiling point, and ejecting the heated gas in communication with the volume of liquid coating material to thereby atomize the coating material and distribute the atomized particles on the heated surface of the keg in the form of a thin uniform coating.

8. A method of coating the interior surface of a keg with a coating material, comprising the steps of heating a meltable coating material to a temperature above the melting point of the material to provide a supply of liquid coating material, continuously feeding said liquid coating material to a reservoir, continuously withdrawing excess liquid coating material from the reservoir to maintain a substantially constant level of coating material in said reservoir, heating a keg to a temperature above the melting point and below the boiling point of said material, heating pressurized gas to a temperature in the range of 10° to 40° F. below the boiling point of said material, and discharging said heated gas through a restricted opening in communication with said volume of liquid coating material to atomize said coating material and distribute the atomized particles on the interior surface of the keg.

9. A method of coating the interior surface of a keg with a coating material, comprising the steps of heating a meltable coating material to a temperature above the melting point of the material to provide a supply of liquid coating material, continuously feeding said liquid coating material to a reservoir, continuously withdrawing excess liquid coating material from the reservoir to maintain a substantially constant level of coating material in said reservoir, heating a keg to a temperature of 5° to 10° F. above the melting point of said material, heating pressurized gas to a temperature in the range of 10° to 40° F. below the boiling point of said material, discharging said heated gas through a restricted opening in a direc-

tion normal to the level of liquid coating material in said reservoir to atomize said material and distribute the atomized particles on the interior surface of the keg, and discharging said heated gas through a second restricted opening in a direction toward said first named direction and at an acute angle to said first named direction to thereby assist in atomizing said material and deflect the atomized particles laterally of said first named direction.

10. A method of coating the interior surface of a keg with a coating material, comprising the steps of heating a meltable coating material to a temperature above the melting point of the material to provide a supply of liquid coating material, continuously feeding said liquid coating material to a reservoir, continuously withdrawing excess liquid coating material from the reservoir to maintain a substantially constant level of coating material in said reservoir, heating a keg to a temperature above the melting point and below the boiling point of said material, heating pressurized gas to a temperature above the temperature of the keg and below the boiling point of said material, heating pressurized gas to a temperature above the temperature of the keg and below the boiling point of said material, discharging said heated gas through a restricted opening in a direction normal to the level of liquid coating material in said reservoir to atomize said material and distribute the atomized particles on the interior surface of the keg, discharging said heated gas through a second restricted opening in a direction toward said first named direction and at an acute angle to said first named direction to thereby assist in atomizing said material and deflect the atomized particles laterally of said first named direction, and discharging said heated gas through a third restricted opening in a direction toward the discharge of gas from the second restricted opening and at an acute angle to said first named direction to thereby assist in atomizing said material and deflect the atomized particles in the opposite direction from the deflection produced by the gas being discharged from said second opening.

11. The method of claim **10** in which the gas is discharged through said first opening throughout the entire cycle and the gas is discharged substantially alternately during said cycle through said second and third openings.

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U.S. Cl. X.R.

117—105.1; 118—317; 239—127, 352, 422

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,488,213 Dated January 6, 1970

Inventor(s) Frank A. Bellato

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 47, cancel "key" and substitute --keg--

Column 5, line 3, cancel "and", second occurrence, and substitute --the--

Column 5, line 9, after "said", first occurrence, insert --gas--

Column 5, line 21, after "connected" insert --to the casing--

Column 5, line 25, cancel "and atomized" and substitute --the atomizing--

Column 7, lines 21-23, cancel "heating pressurized gas to a temperature above the temperature of the keg and below the boiling point of said material," which was repeated twice.

SIGNED AND
SEALED
JUL 21 1970

SEAL)
Attest:

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Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents