United States Patent

[11] 3,620,231

[72] Inventor **Carl A. Miller**
Saint Paul, Minn.

[21] Appl. No. **1,229**
[22] Filed **Jan. 7, 1970**
[45] Patented **Nov. 16, 1971**

[73] Assignee **Economics Laboratory, Inc.**
Saint Paul, Minn.

[54] **FOAM-GENERATING APPARATUS AND METHOD OF USE**
12 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **134/15,** 117/105.3, 117/104 R, 134/72, 134/151, 259/147, 261/DIG. 26, 415/115

[51] **Int. Cl.** **B08b 3/08,** B08b 1/02

[50] **Field of Search** ..... 401/190, 4; 261/DIG. 26; 134/15, 22, 29, 68, 72, 131, 151; 415/115; 259/147; 117/104 R, 105.3

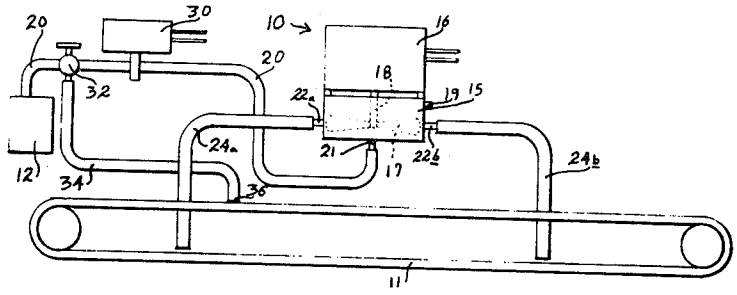
[56] **References Cited**

UNITED STATES PATENTS

1,141,243	6/1915	Foster	134/29
1,254,429	1/1918	Parmeley	401/4
2,563,151	8/1951	Bjorksten	134/29 UX
2,849,215	8/1958	Hurst	251/DIG. 26
2,990,165	6/1961	Joseph	261/DIG. 26
3,037,887	6/1962	Brenner et al.	134/22 R
3,436,262	4/1969	Crowe et al.	134/22 R
3,377,120	4/1968	Koutsonicolas	401/4

Primary Examiner—Morris O. Wolk
Assistant Examiner—R. E. Serwin
Attorney—Merchant & Gould

ABSTRACT: Apparatus for generating a foamed lubricant-cleanser comprising a cylindrical chamber having an air inlet and a lubricant-cleanser solution inlet in opposite ends thereof and a plurality of equidistant foam outlets about the periphery thereof. The lubricant-cleanser solution is introduced into the chamber proximate the center of a fan positioned for rotation therein about an axis coincident with the axis of symmetry of the cylindrical chamber. The nonfoamed solution is converted into foam by the introduction of air into the nonfoamed solution centrifugally propelled by the fan. A method for lubricating and cleansing a moving surface such as a conveyor is also disclosed.



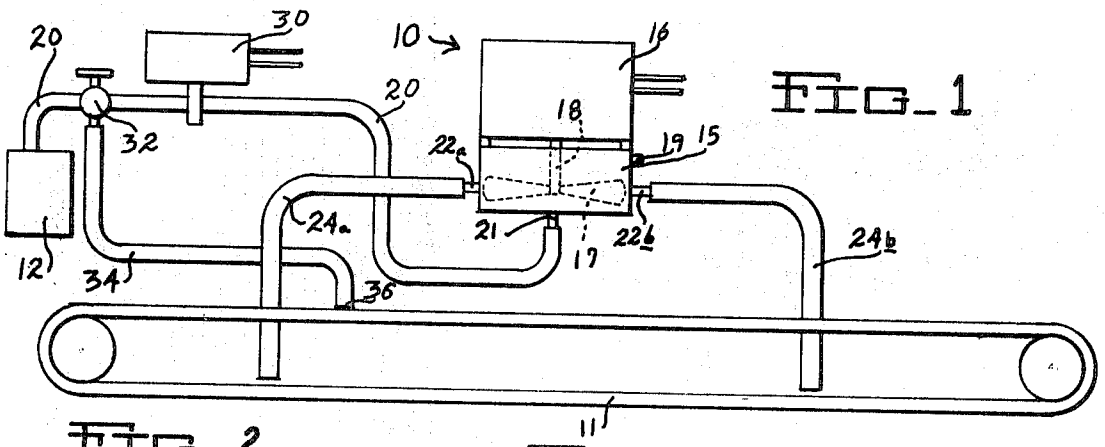


FIG_1

FIG_2

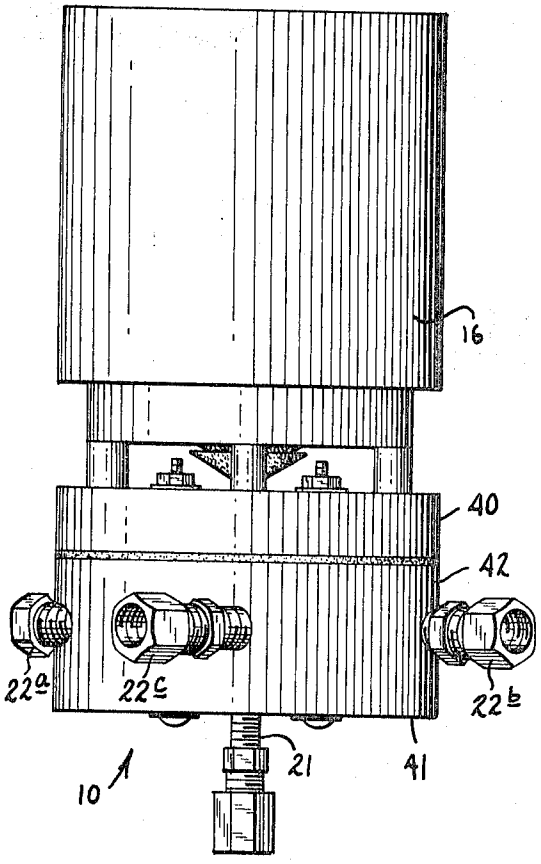


FIG_3

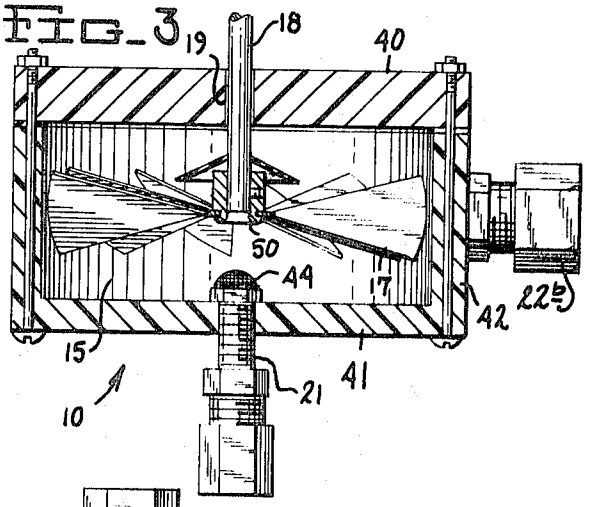
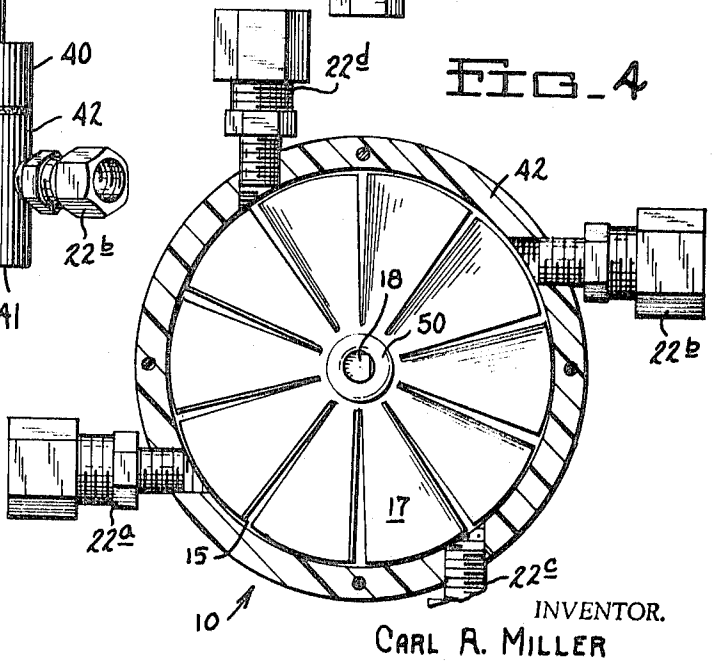


FIG_4



INVENTOR.
CARL R. MILLER
BY
Merchant & Gould
ATTORNEYS

FOAM-GENERATING APPARATUS AND METHOD OF USE

FOAM GENERATING APPARATUS

Background of the Invention

The present invention relates to foam-generating apparatus and particularly to foam-generating apparatus adapted for utilization in a system for lubricating and cleaning a moving surface.

Apparatus which reduces the amount of lubricant needed to provide proper lubrication of a moving surface has long been sought and is commercially desirable. Recently, the utilization of a foamed lubricant has been found to reduce the volume of lubricant necessary for this purpose. Furthermore, when the moving surface is a conveyor, such as is utilized to transport food products during the processing thereof, the utilization of a foamed lubricant prevents lubricant drippage from overhead conveyors onto the food products.

The prior art foam generators available for utilization in a system for lubricating a moving surface are neither reliable or efficient. Generally, the screw-type air-liquid mixers in the prior art foam generators have required high r.p.m., AC/DC universal-type electric motors. Such motors will not operate over an extended time period such as is required in industrial use. Furthermore, the liquid-air mixers utilized in the prior art devices have not readily generated foam of the desired consistency nor has it been possible to generate foam at a given consistency over even a short period of time

SUMMARY OF THE INVENTION

The foam-generating apparatus of the present invention comprises a chamber and an impeller means mounted therein suitable for mixing air with a nonfoamed liquid. The chamber includes an air inlet and an inlet means for introducing a nonfoamed liquid into the chamber and proximate the impeller. The chamber further includes an outlet for exhausting foam generated within the chamber. When the foam generator is utilized in a system for lubricating and cleansing a surface, a first liquid conduit is provided to transmit a nonfoamed lubricant-cleanser solution contained within a solution reservoir to the foam generating chamber. A foam conductor is provided for dispersing generated foam onto the surface. In addition, a second liquid conduit is provided to transmit the nonfoamed solution directly from the solution source to a nozzle means which is positioned to direct a spray of the solution directly onto the surface.

The foam generating apparatus defined by the present invention provides dependable and efficient foam generation. The design of the impeller utilized to generate foam allows the utilization of small nonbrush-type electric motors such as a split-phase-type electric motor. Such motors are considerably less expensive and are operable over a much longer time period than the universal-type motors required by the prior art foam generators. Furthermore, foam of a desired consistency is readily generated by the foam-generating apparatus of the present invention. As described hereinbelow, the foam generator provided by the present invention can be advantageously utilized in a system for lubricating and cleaning a moving surface such as a conveyor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 schematically illustrates the foam-generating apparatus of the present invention adapted for utilization in a system for lubricating and cleaning a conveyor;

FIG. 2 illustrates a preferred embodiment of the foam-generating apparatus provided by the present invention;

FIG. 3 is a cross-sectional view of the foam-generating apparatus illustrated in FIG. 2; and

FIG. 4 is a top cross-sectional view of the foam-generating apparatus illustrated in FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in FIG. 1, the foam-generating apparatus, generally designated **10**, is utilized in a system for lubricating and cleaning a moving surface such as conveyor **11**. A combination lubricant and cleansing composition is contained in solution form in a reservoir **12**. Preferably, the solution is aqueous. Lubricant-cleanser combinations such as those comprising a wetting agent blended with water, alcohol and a sequestering agent are well-known in the art. For example, one such composition is sold under the name Klenzglide and is manufactured by Economics Laboratory, Inc. It should be understood, however, that foam-generating apparatus **10** can be utilized in various systems other than in a system such as shown in FIG. 1.

As illustrated, foam-generating apparatus **10** comprises an enclosed foam-generating chamber **15** having a substantially circular cross section. An impeller such as fan **17** is positioned within foam-generating chamber **15** and is mounted on a shaft **18** which extends vertically upward out of chamber **15** to a drive means **16**. As illustrated, fan **17** is mounted for rotation about an axis substantially perpendicular to the circular cross section of chamber **15**. An air inlet **19** is adapted to introduce air into chamber **15**. The air can be introduced at either atmospheric pressure or under an elevated pressure such as 2 pounds per square inch.

A first liquid conduit means **20** has a first end connected to lubricant-cleanser reservoir **12** and a second end connected to a solution inlet **21** in chamber **15**. Solution inlet **21** is adapted to introduce the nonfoamed solution into chamber **15** proximate the center of fan **17**. For purposes of the present invention, the introduction of the nonfoamed solution is considered proximate fan **17** whenever the air currents created by the rotating fan centrifugally propel the solution toward the walls of chamber **15**. Foam conductors **24*a*** and **24*b*** are connected to foam outlets **22*a*** and **22*b***, respectively, in chamber **15** and are arranged so as to conduct the foam generated within the foam-generating chamber to conveyor **11**.

Connected to first solution conduit means **20** are a pressure control means **20** and a two-way valve means **32**. In the preferred embodiment, pressure control means **30** comprises a solenoid valve electrically connected to a remotely located switch (not shown) for "on-off" control of the flow of nonfoamed solution through first conduit means **20**. Pressure control means **30** further comprises an adjustable pressure control valve having a manually operable pressure adjustment screw for reducing the pressure of the solution flow in the downstream side of control means **30**. A pressure control valve of conventional construction is utilized. Two-way valve means **32** is a manually operated two-way valve and is connected to conduit **20** to provide alternate paths for the lubricant-cleanser solution flow. That is, when two-way valve means **32** is in a first position, the entire solution continues to flow through conduit **20** to chamber **15**, whereas when the two-way valve is in a second position the entire solution flow is directed into a second liquid conduit means **34** and out through a nozzle means **36** onto conveyor **11**. Nozzle means **36** is a conventional spray head.

In the preferred embodiment, the pressure of the nonfoamed solution exhausted or pumped from reservoir **12** is within the range of 10–50 pounds per square inch. The pressure of the solution flow entering chamber **15** through orifice **21** is within the range of one-eighth to 40 pounds per square inch. The pressure can be readily varied by varying the solution pressure within reservoir **12** or by varying the size of orifice **21**. The composition of first and second liquid conduit means **20** and **34** and foam conducting means **24*a*** and **24*b*** is not critical. In the preferred embodiment, polyethylene tubing is utilized. In the case where conveyor **11** is designed to transport food products during the processing thereof, the lubricant-cleanser solution is preferably an aqueous solution of

Klenzglide 5. However, when the contact of the lubricant-cleanser with the transported product will not be harmful, an aqueous solution of Klenzglide 1 can be utilized.

In operation, a pump (not shown) such as a rotary-type pump is activated in solution reservoir 12 so as to pump the liquid therefrom into conduit 20. With two-way valve means 32 in the first position, the nonfoamed solution is transmitted along conduit 20 to pressure control means 30. At this point, the pressure of the nonfoamed solution is reduced from a first pressure to a second (nonzero) pressure. The nonfoamed solution at the second pressure is then transmitted through orifice 21 into chamber 15 proximate the center of fan 17. Upon introduction into chamber 15 in such a manner, the solution is centrifugally propelled outward towards the cylindrical walls of chamber 15. During this propulsion, air is introduced into the nonfoamed solution resulting in a foamed product. The generated foam is centrifugally propelled onto the sidewalls of chamber 15 and moves along the walls of the chamber in the same direction as the rotation of fan 17. The foam is then exhausted from the chamber through outlets 22*a* and 22*b* into foam conductors 24*a* and 24*b*, respectively. The introduction of a pressurized air flow through inlet 19 facilitates the exhaustion of foam from chamber 15, but is not necessary to obtain operation of the present invention. The exhausted foam is transported through conductors 24*a* and 24*b* and dispersed at a desired point along conveyor 11. The beads of foam dispersed onto conveyor 11 lubricate the belt and greatly reduce the amount of drive powder necessary to operate conveyor 11. It is readily apparent that some cleansing action will occur during this stage of operation. However, the dispersement of the foamed lubricant-cleanser onto the conveyor is primarily for the purpose of lubrication. As explained previously, the utilization of a foamed lubricant prevents lubricant drippage from overhead conveyors.

To provide a more thorough cleansing of conveyor 11, it is desirable to spray a cleansing solution directly onto the conveyor belt. In the present invention, such a cleansing action is provided by manually positioning two-way valve 32 in the second position thereby directing the entire lubricant-cleanser flow into conduit 34. The solution flow through conduit 34 is then directed onto conveyor 11 by spray head 36. As illustrated, two-way valve 32 is connected to conduit 20 upstream form pressure control means 30 so that the pressure flow through nozzle 36 is at the unreduced pressure. As a result, the spray provided by nozzle 36 provides fast and efficient cleaning of conveyor 11. During the cleansing stage of operation, the products, such as food, being transported on conveyor 11 are normally removed therefrom.

A preferred embodiment of the foam-generating apparatus schematically illustrated in FIG. 1 is shown in FIGS. 2–4. Where appropriate, the same reference numerals as used in FIG. 1 have been used to designate corresponding elements of the foam generator.

In the preferred embodiment illustrated in FIG. 2, drive means 16 is a 1/20th-horsepower 3,000r.p.m. split-phase-type motor. Such motors are reasonably priced and provide dependable service over an extended time period. However, other types of electric motors can be utilized.

As can be seen in FIG. 3, foam generating chamber 15 is cylindrically shaped. The cylindrically shaped chamber is formed by top and bottom plates 40 and 41, respectively, and cylindrical sidewalls 42. In the embodiment illustrated in FIG. 3, fan shaft 18 extends out of chamber 15 through air inlet 19 which is positioned in top plate 40 above fan 17. To facilitate the regulation of the nonfoamed liquid flow into chamber 15, the embodiment illustrated includes a nozzle means 44 connected to orifice 21. Nozzle means 44 is a conventional spray head. It should be understood, however, that the utilization of spray head 44 is not critical to the operation of the present invention. As can be further seen from FIG. 3, fan 17 rotates about an axis of rotation coincident with the axis of symmetry of cylindrical chamber 15. Orifice 21 and spray head 44 are positioned along the axis of rotation immediately below the center of fan 17. Such an orientation provides optimum foam generation.

The cross-sectional top view of the foam-generating chamber shown in FIG. 4 illustrates the preferred positioning of the foam outlets. As illustrated, the center line or longitudinal axis of each outlet is at approximately a 60° angle with respect to a line drawn tangent to chamber 15 at each respective opening. Outlets 22*a*, 22*b*, 22*c* and 22*d*, are positioned about the periphery of cylindrical chamber 15 at equal distances from one another. This positioning of the foam outlets optimizes the exhaustion of the foam from chamber 15. However, it is to be understood that other arrangements of the foam outlets, such as perpendicular to the periphery of chamber 15, will also provide adequate foam exhaustion. As can be further seen from FIG. 4, fan 17 has a plurality of blades radiating from hub shaft 18. Although the specific construction of fan 17 is not critical for the operation of the present invention, it has been found experimentally that a configuration substantially identical with that illustrated in FIGS. 3 and 4 provides optimum foam generation. A fan manufactured from aluminum or one of various plastics can be utilized.

In the embodiment illustrated in FIGS. 2–4, chamber 15 has a diameter of three and one-sixteenth inches and fan 17 has a diameter of three inches. Spray head 44 is positioned at a distance of one-half inch below fan 17. Finally, orifice 21 has a diameter of approximately twenty-five-thousandths of an inch. Utilizing the embodiment illustrated in FIGS. 2–4, a lubricant-cleanser foam is obtained having a consistency approximately at the midpoint in the range between what is normally considered as wet and dry foams. The consistency of the foam can be selectively varied, however, by varying the pressure at which the nonfoamed solution is introduced into chamber 15.

While the present invention has been described in conjunction with one preferred foam generator, it will be apparent to those of ordinary skill in the art that modifications can be made in this embodiment without departing from the spirit and scope of the present invention. Furthermore, it is readily apparent that the foam generator described herein can find other applications than in the lubrication-cleansing system described in conjunction with FIG. 1.

What is claimed is:

1. Apparatus for generating foam comprising:
   a. means defining a substantially enclosed chamber;
   b. impeller means including a fan mounted on a shaft for rotation within said chamber;
   c. first inlet means suitable for introducing a nonfoamed liquid into said chamber and proximate said fan;
   d. second inlet means suitable for introducing air into said chamber; and
   e. a plurality of outlets positioned about the periphery of said chamber suitable for exhausting foam from said chamber.

2. The apparatus of claim 1 wherein:
   a. said chamber is substantially cylindrically shaped;
   b. said shaft extends out of said chamber to drive means, said fan rotating in a generally horizontal plane about an axis generally coincident with the longitudinal axis of said cylindrical chamber; and
   c. said nonfoamed liquid inlet means comprises and opening in said chamber below said fan and is adapted to introduce said nonfoamed liquid into said chamber proximate the center of said fan.

3. The apparatus of claim 2 wherein:
   a. said air inlet is positioned in a horizontal end of said cylindrical chamber above the fan;
   b. said nonfoamed liquid inlet means includes a nozzle means positioned within said cylindrical chamber and in communication with said nonfoamed liquid opening, said nonfoamed liquid opening being positioned in a horizontal end of said cylindrical chamber below said fan;
   c. said plurality of openings for exhausting the foam are spaced generally coplanar and equidistant from one another, each of said plurality having a longitudinal axis

at approximately a 60° angle with respect to a line drawn tangent to said cylindrical chamber at each of said outlets;

d. said fan is positioned within said cylindrical chamber in generally the same plane as said outlets for centrifugally propelling the foam along the cylindrical walls of said chamber and outward through said outlets;

e. said drive means is an electric motor; and

f. said nonfoamed liquid is an aqueous lubricant and cleanser solution.

4. A system for lubricating a surface, comprising:

a. means defining an enclosed reservoir for containing a liquid lubricant at a first pressure;

b. means defining a chamber having fan means mounted therein for centrifugally propelling liquid lubricant introduced into said chamber proximate said fan means so as to generate foam and including an air inlet, an inlet for introducing the liquid lubricant into said chamber and proximate said fan means, and a plurality of generally coplanar outlet openings positioned about said chamber for receiving the centrifugally propelled foam to exhaust the foam from said chamber;

c. first liquid conduit means connecting said reservoir and said liquid inlet in said foam generating chamber; and

d. means defining a foam conductor connected to said foam exhaust outlet and suitable for dispersing foam onto said surface.

5. The system of claim 4 wherein:

a. said chamber has a substantially cylindrical shape;

b. said fan means is mounted for rotation about an axis substantially coincident with the axis of symmetry of said cylindrical chamber;

c. said plurality of generally coplanar outlet openings are positioned generally equidistant from one another about the periphery of said cylindrical chamber;

d. said foam conductor means includes a plurality of conduits each connected to a different one of said outlets for dispersing foam onto a plurality of points on said surface; and

e. said liquid lubricant is combined with a cleansing agent to provide a lubricant-cleanser solution.

6. The system of claim 5 including second liquid conduit means and nozzle means for cleaning the surface wherein:

a. said second liquid conduit means has an inlet in communication with the solution reservoir and an outlet connected to said nozzle means; and

b. said nozzle means is positioned to direct a spray of said lubricant-cleanser solution onto said surface.

7. The system of claim 6 including pressure control means for reducing said first solution pressure to a second solution pressure, said pressure control means being connected to said first conduit means between said solution reservoir and said chamber.

8. The system of claim 7 including means defining a two-way valve having an inlet and a first and second outlet wherein:

a. said inlet and said first outlet of said two-way valve are connected to said first conduit and said second outlet of said two-way valve is connected to said inlet of said second conduit; and

b. said pressure control means is connected to said first conduit between said two-way valve and said chamber and includes a pressure regulator valve and solenoid valve means electrically connected to a remote switch means; and

c. said surface is a conveyor.

9. A method for lubricating and cleaning a surface, comprising;

a. providing a liquid lubricant-cleanser solution at a first pressure;

b. reducing the pressure of said liquid solution to a second pressure;

c. introducing said liquid solution at said second pressure into a foam generator proximate an impeller mounted for rotation therein;

d. exhausting the foamed lubricant-cleanser from said foam generator through outlet means in said foam generator;

e. dispensing the exhausted lubricant-cleanser foam onto said surface thereby lubricating said surface;

f. terminating the introduction of said liquid solution into said foam generator; and

g. spraying said liquid solution at said first pressure directly onto said surface thereby cleaning said surface.

10. The method of claim 9 wherein said liquid solution is introduced into means defining a chamber having an impeller means mounted therein and including an air inlet, an inlet for introducing the liquid solution into said chamber and proximate said impeller means and an outlet for exhausting foam generated within said chamber.

11. The method of claim 10 wherein:

a. said chamber is substantially cylindrically shaped;

b. said impeller means comprises a fan mounted on an axis of rotation coincident with the axis of symmetry for said cylindrical chamber and

c. said surface is a conveyor.

12. The method of claim 11 wherein:

a. said conveyor is adapted to move food substances during the preparation thereof;

b. said foamed lubricant-cleanser is dispersed onto said conveyor during the preparation of said food substances; and

c. said liquid lubricant-cleanser solution is sprayed onto said conveyor after the removal of said food substances from said conveyor.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,620,231 Dated November 16, 1971

Inventor(s) Carl A. Miller

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 42, cancel "20" and insert -- 30 -- ; line 65, after "inch. The", insert -- pressure is then reduced by pressure control means 30 so that the -- . Column 3, line 29, cancel "powder" and insert -- power -- ; line 44, cancel "form" and insert -- from -- . Column 4, line 55, cancel "2" and insert -- 1 -- .

Signed and sealed this 12th day of December 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

ORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—365-334.