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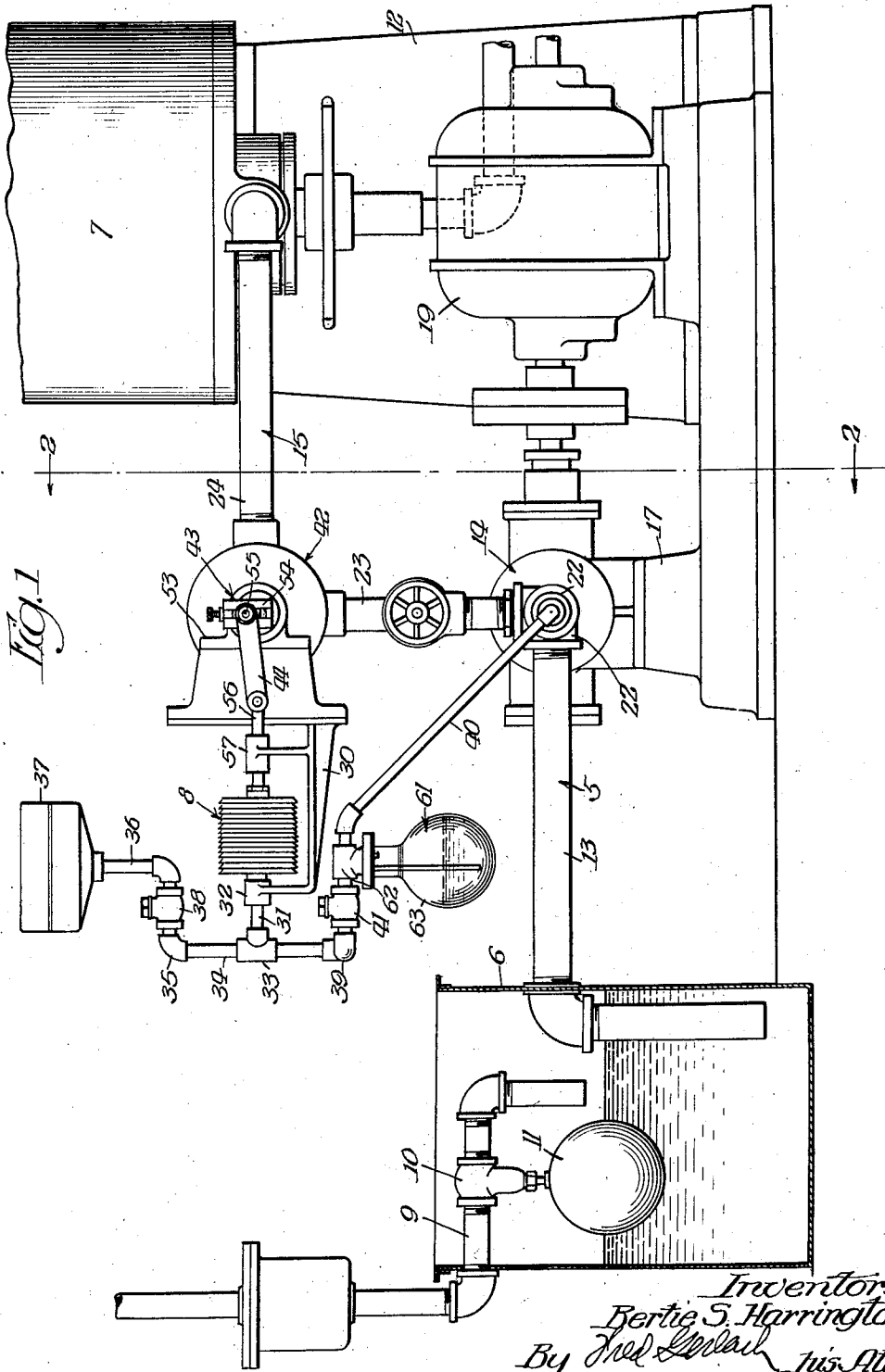
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GAS AND LIQUID MIXING APPARATUS

Filed Dec. 2, 1939

2 Sheets-Sheet 1



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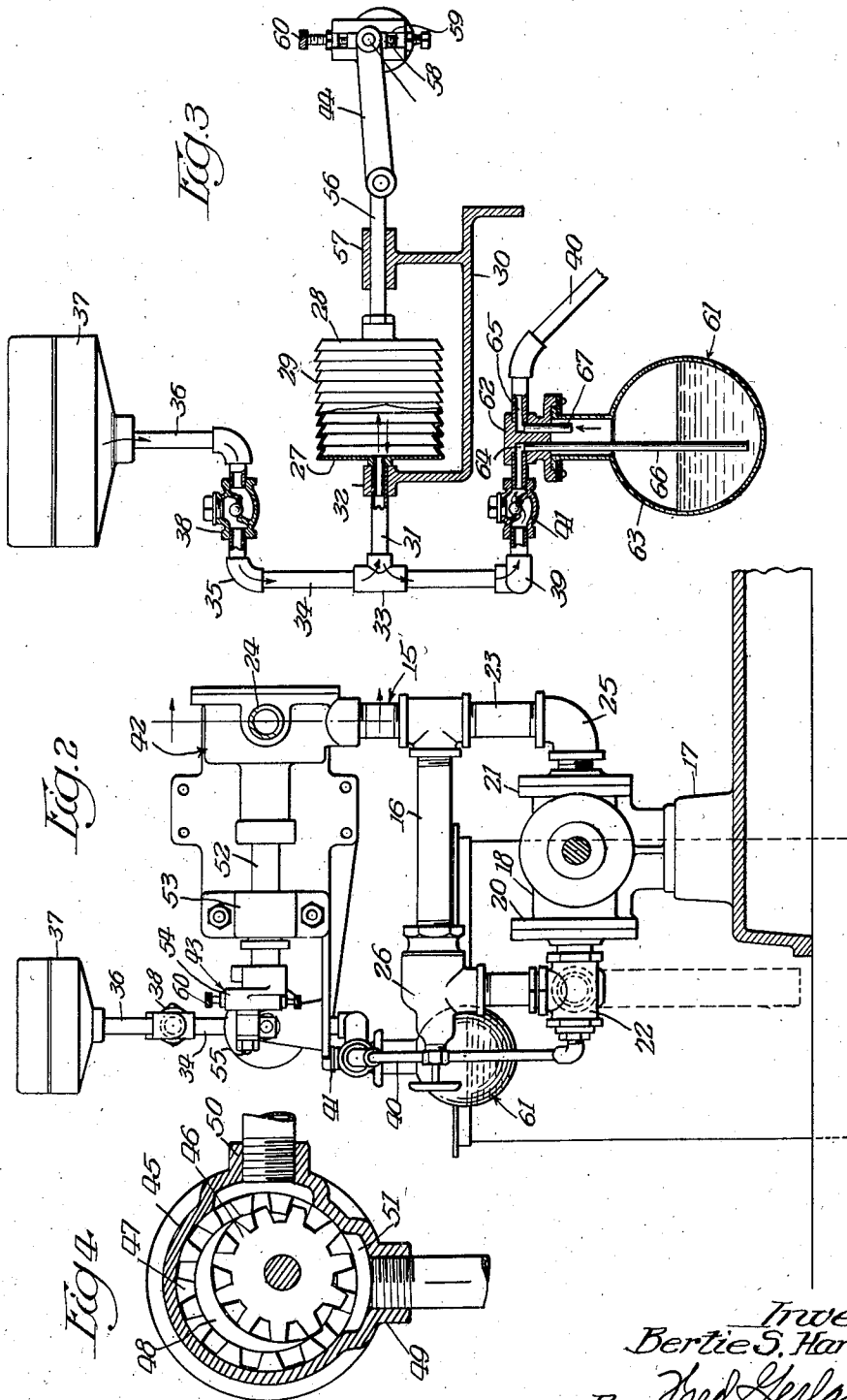
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UNITED STATES PATENT OFFICE

2,306,601

GAS AND LIQUID MIXING APPARATUS

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Application December 2, 1939, Serial No. 307,239

2 Claims. (Cl. 137—165)

The present invention relates generally to apparatus for mixing gas and liquid. More particularly the invention relates to that type of apparatus which is primarily adapted to mix air with congealable liquid material such as liquid lard or vegetable oil shortening in order properly to color it and comprises as its principal or main parts a pipe system for flowing the material from a storage tank to a chilling machine for congealing purposes and a pump for pumping air into the material as it flows through the pipe system.

In mixing air and congealable liquid material such as lard or vegetable oil shortening for coloring purposes it is necessary to maintain constancy of proportion of air to the material for the reason that the density of the final product must always be uniform. It has heretofore been proposed in connection with the type of apparatus here under consideration to drive the pump for introducing or pumping the air into the material by way of steam, air under pressure or an electric motor. In practice it has been found that when a steam, compressed air, or motor driven pump is employed and there is any change in the rate of flow of the congealable liquid material through the pipe system the percentage or proportion of air to the material changes and there is no uniformity in the density of the final product.

The primary object of the present invention is to provide a mixing apparatus of the type under consideration which is an improvement upon and is more efficient and accurate than previously designed apparatus for the same purpose by reason of the fact that the pump is driven in response to the flow of the material through the pipe system and hence operates to maintain constancy of the proportion or percentage of air to material at all times, i. e., regardless of any variation in the rate of flow of the material through the system.

Another object of the invention is to provide a mixing apparatus of the last mentioned character in which the actuating means for the pump embodies a rotary device which is included in and forms a part of the pipe system and comprises a casing through which the material flows in transit from the storage tank to the chilling machine and in addition a rotor which is mounted in the casing, rotates in response to the flow of the material in the casing and is connected to drive the pump by way of a crank pitman.

Another object of the invention is to provide a mixing apparatus of the type and character last

mentioned in which the crank for imparting motion to the pitman in response to drive of the rotary device has a crank pin which is radially adjustable with respect to the rotor in order that the stroke of the pitman may be varied in order to change, if desired, the proportion or percentage of air with respect to the material.

A further object of the invention is to provide a mixing apparatus of the type under consideration in which the pump is in the form of a bellows as contradistinguished from a piston or gear type pump and hence requires the use of no lubricant which would contaminate the material if entrained with the air and pumped into the material.

A still further object of the invention is to provide a gas and liquid mixing apparatus which is generally of new and improved construction and design, requires a minimum of power input and may be manufactured at a low and reasonable cost.

Other objects of the invention and the various advantages and characteristics of the present gas and liquid mixing apparatus will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by the claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a side view of a mixing apparatus embodying the invention, parts being shown in section for the purpose of illustration;

Figure 2 is a vertical transverse section taken on the line 2—2 of Figure 1 and showing in detail the arrangement and design of the air pump and the pump actuating means;

Figure 3 is an enlarged side elevation of the pump and associated equipment, parts being shown in section; and

Figure 4 is a section of the rotary device which is included in and forms a part of the pipe system of the apparatus and constitutes a part of the actuating means for the air pump.

The apparatus which is shown in the drawings constitutes the preferred embodiment of the invention. It is primarily adapted or designed for mixing air with congealable liquid material, such for example as liquid lard or vegetable oil shortening for coloring purposes and comprises a pipe system 5 for flowing the material from a storage

or supply tank 6 to a chilling machine 7, and in addition a pump 8 for pumping air into the material as it flows through the pipe system 5. The tank 6 is preferably an open top tank on the floor of the room in which the apparatus is employed, and receives the congealable liquid material from a pipe 9. The discharge end of the pipe 9 extends into the tank 6 and is provided with a gate valve 10. The latter is controlled by means of a ball type float 11 in such manner that there is always a uniform supply of material in the tank 6. The chilling machine 7 is positioned at one side of the tank 6 and is supported on a bracket 12. It is adapted to receive the material under pressure from the pipe system 5 and operates to chill the material in order to congeal it.

The pipe system 5 comprises an inlet pipe 13, a pump 14, an outlet pipe 15 and a by-pass pipe 16. The pump 14 is of the screw type and is carried by a supporting structure 17 at one side of the tank 6. It comprises an elongated horizontally extending casing 18 and a screw type rotor (not shown) and is driven by means of an electric motor 19 on the supporting structure 17. The casing 18 houses the screw type rotor and embodies an inlet 20 and an outlet 21. The inlet pipe 13 of the pipe system extends between the tank 6 and the pump 14. One end of the inlet pipe extends into the tank 6 as shown in Figure 1 and the other end is connected to the inlet 20 of the pump casing 18 by way of a fitting 22. The outlet pipe 15 of the pipe system extends between the pump 14 and the chilling machine 7 and consists of a vertically extending section 23 and a horizontally extending section 24. The lower end of the section 23 of the outlet pipe is connected by an elbow 25 to the outlet 21 of the pump casing 18. The screw type rotor of the pump 14 is so arranged that when it is driven as the result of operation of the electric motor 19 congealable liquid material is drawn from the tank 6 through the inlet pipe 13 into the pump casing 18 and is then discharged under pressure from the pump casing outlet to the chilling machine 7 via the elbow 25 and the two sections 23 and 24 constituting the outlet pipe 15 of the pipe system 5. The by-pass pipe 16 extends between and is connected to the vertically extending section 23 of the outlet pipe 15 and the fitting 22 whereby the inlet pipe 13 is connected to the inlet 20 of the pump casing 18. It is adapted to permit a portion of the pumped material to bypass back to the inlet of the pump and includes a control valve 26. By adjusting this valve the amount of material flowing through the by-pass may be controlled and the rate of flow of the material passing into the chilling machine may thus be regulated. When it is desired to increase the rate of flow of the material to the chilling machine the valve 26 is closed and when it is desired to decrease the rate of flow of the material to the chilling machine the valve is opened.

The pump 8 for pumping or introducing air under pressure into the material as the latter flows through the pipe system 5 is in the form of a bellows and consists of a pair of circular rigid end walls 27 and 28 and an accordion-like cylindrical side wall 29 between the two end walls. It is adapted to be expanded and contracted as hereinafter described for air pumping purposes and is positioned above a horizontally extending supporting arm 30. The end walls extend vertically and the side wall extends horizontally as shown in Figures 1 and 3. A horizontally extend-

ing pipe 31 together with the arm 30 serves to support the pump 8. This pipe extends through and is fixed within a tubular member 32 on the arm 30. One end of the pipe 31 is connected to the central portion of the end wall 27 of the pump 8 and communicates with the interior of the pump. The other end of the pipe 31 is connected by a T fitting 33 to a vertically extending pipe 34. The upper end of the last mentioned pipe is connected by an elbow 35 and an L-shaped pipe 36 to an air strainer 37 over the bellows type pump 8. When the pump 8 is expanded air from the atmosphere surrounding the apparatus flows through the air strainer 37, the pipe 36, the upper end of the vertically extending pipe 34 and the pipe 31 into the interior of the pump 8. A ball type check valve 38 is included in the L-shaped pipe 36 and serves to prevent outflow of air through the air strainer 37 when the pump 8 is contracted or compressed. The lower end of the pipe 34 is connected by a fitting 39 and a pipe 40 to the fitting 22 between the inlet pipe 13 of the pipe system 5 and the inlet 20 of the casing 18 of the pump 14. When the bellows type pump 8 is contracted or compressed the air in the interior of the pump is forced under pressure through the pipe 31, the lower end of the pipe 34, the fitting 39 and the pipe 40 into the material directly before the latter flows into the pump casing 18. A ball type check valve 41 is included in the pipe 40 and serves to prevent reverse flow of air through the pipe 40 when the bellows type pump 8 is expanded. When the pump 8 is expanded air is drawn into it through the air strainer 37, the pipe 36, the upper end of the pipe 34 and the pipe 31, as hereinafter described. When the pump is compressed or contracted the air within the pump is forced under pressure through the lower end of the pipe 34, the fitting 39, the check valve 41 and the pipe 40 into the material. The pump 8 is adapted to be continuously expanded and contracted during flow of the material through the pipe system 5 with the result that air under pressure is introduced or pumped into the material.

In addition to the pipe system 5 and the bellows pump 8 the apparatus includes means for actuating the pump 8 in response to flow of the material through the pipe system 5. This means comprises a rotary device 42, a crank 43 and a pitman 44. The rotary device 42 is in effect a meter of the gear pump type. It is included in the pipe system 5 and consists of a casing 45, a gear 46, a ring gear 47 and a crescent shaped partition 48. The casing 45 embodies an inlet 49 and an outlet 50. The inlet is connected to the upper end of the vertical section 23 of the outlet pipe 15 and the outlet 50 of the casing 45 is connected to the inlet end of the horizontally extending section 24 of the outlet pipe 15. As a result of the manner in which the inlet and outlet of the casing 45 are connected the material under pressure flows through the casing 45 prior to delivery to the chilling machine 7. The flow of the material through the casing 45 of the rotary device 42 serves to drive the gear 46 and the latter in turn, as hereinafter described more in detail, operates to drive the crank 43. The gear 46 is rotatably mounted in a chamber 51 in the casing 45 and between and in communication with the inlet 49 and the outlet 50. It is eccentrically disposed in the chamber 51 and is provided with a shaft 52 which is journaled in a bearing in one of the side walls in the casing 45. The ring gear 47 corresponds in diameter to and

is rotatably mounted within the chamber 51 and meshes with the gear 46, as shown in Figure 4 of the drawings. The crescent shaped partition 48 is stationary and fits within and seals the crescent shaped space between the gear 46 and the ring gear 47. When the material under pressure flows through the casing 45 of the rotary device 42 it traverses the chamber 51 as it passes from the inlet 49 to the outlet 50 and in passing through the spaces between the teeth of the gear and the teeth of the ring gear it causes the gear 46 together with its shaft 52 to rotate. The gear 46 constitutes the rotor of the rotary device and the speed of drive or rotation depends upon the rate of flow of the material through the casing 45. The shaft 52 extends horizontally and is journaled in a bearing 53 on the supporting arm 30 and carries the crank 43 at its outer end. The arm 30, as shown in Figure 2, is fixed to and supported by the casing 45 of the rotary device 42. The crank is horizontally aligned with the bellows type pump 8 and consists of a crank arm 54 and a crank pin 55. The crank arm is fixed to and rotates from the shaft 52 and hence revolves or rotates in connection with drive of the shaft 52. The crank pin is carried by the arm 54 eccentrically of but parallel to the shaft 52 and is connected to the end wall 28 of the bellows type pump 8 by way of the pitman 44 and a slide rod 56. The slide rod is slidably mounted in a bearing 57 on the supporting arm 30 and has one end thereof fixedly connected to the end wall 28. The pitman 42 extends between and is pivotally connected to the pin 55 of the crank 43 and the other end of the slide rod 56. When the rotary device 42 is in operation as the result of flow of material through the casing 45 thereof the crank 43 is rotated and operates through the medium of the pitman 44 and the slide rod 56 successively and continuously to expand and contract the bellows type pump 8 with the result that the latter pumps air into the pipe system 5, as hereinbefore described. By reason of the fact that the speed of drive of the rotary device 42 depends upon the rate of flow of the material in transit through the pipe system 5 the percentage or proportion of air which is introduced into the material by the pump 8 is constant or uniform at all times regardless of any change in the rate of flow of the material. If for any reason the rate of flow of the material in transit through the pipe system 5 should increase there is a corresponding increase of drive of the rotary device 42 with a corresponding increase in the amount of air which is delivered by the pump into the material. Should the rate of flow of the material in transit through the pipe system 5 decrease for any reason there is a decrease in the drive of the rotary device 42 and a corresponding decrease in the action of the pump 8. The rotary device 42 together with the crank 43, and the pitman 44 constitutes simple means for actuating the pump 8 correspondingly to the flow of the material through the pipe system 5. The crank pin 55 of the crank 43 is connected to the crank arm 54 by a block 58 and a slideway 59 so that it is radially adjustable with respect to the shaft 52. The slideway 59 is formed in and extends longitudinally of the crank arm 54. The block 58 is slidably mounted in the slideway and is held in its various adjusted positions by means of a pair of opposed set screws 60 at the ends of the crank arm. By adjusting the set screws the crank pin may be shifted radially outward or radially inward with respect to the shaft 52. By adjusting the position

of the crank pin the stroke of the pitman may be regulated so as to cause the pump 8 to deliver any desired proportion or percentage of air to the material. If it is desired to increase the amount of air the crank pin 55 is adjusted or shifted away from the shaft 52 whereas if it is desired to decrease the proportion or percentage of air with respect to the material the crank pin is shifted inwards by proper manipulation of the set screws 60. The set screws 60 together with the block 58 and slideway 59 constitute simple means for adjusting the stroke of the pitman and controlling or regulating the amount of air which is introduced by the pump 8 into the material.

In order to permit the operator of the apparatus to ascertain whether the pump 8 is operative during operation of the apparatus as a whole a visible flow indicator 61 is provided. This indicator is connected to the pipe 40 at a point between the ball type check valve 41 and the fitting 22 and comprises a fitting 62 and a transparent container 63. The container is connected to and depends from the fitting 62 and is adapted to be partially filled with oil or other material having extremely low volatility. The fitting 62 embodies an inlet port 64 and an outlet port 65. The tube 66 is connected to the discharge end of the inlet port 64 and extends downwardly into the bottom of the container 63. A short tube 67 is connected to the inlet end of the outlet port 65 and is disposed above the oil or other liquid in the container 63. The air which is pumped by the bellows type pump 8 into the material in transit through the pipe system 5 flows, after first passing through the ball type check valve 41, downwardly into the oil or other liquid through the tube 66 and then, after bubbling through the liquid, flows into the pipe 40 via the short tube 67. When the apparatus is in operation the bubbles resulting from the flow of air through the liquid in the container 63 indicate that the pump 8 is functioning properly. If there are any impurities in the air passing from the pump into the pipe system 5 such impurities are removed by the liquid in the container 63 as the air flows or bubbles therethrough. Although the indicator 61 has been described as being connected to the pipe 40 at a point between the check valve 41 and fitting 22 it is to be understood that it may be applied at other points, such for example as at a point between the air strainer 37 and the check valve 31. At such a point the apparatus would not become inoperative as far as the air pump is concerned in the event of breakage of the container 63.

Assuming that current is being supplied to the electric motor 19 the operation of the apparatus is as follows:

The screw type pump 14 operates to draw the material from the tank 6 through the inlet pipe 13 of the pipe system 5 and to force the material under pressure through the outlet pipe 15 to the chilling machine 7. As the material flows from the vertical section 23 of the outlet pipe 15 through the casing 45 of the rotary device 42 to the horizontally extending section 24 it serves to drive the device 42. In response to drive of the device 42 the crank 43 is rotated and operates through the medium of the pitman 44 and the slide rod 57 successively and continuously to expand and contract the pump 8. When the pump is expanded air is drawn into the interior thereof via the strainer 37, the L-shaped pipe 36, the upper end of the pipe 34 and the pipe 31. When the pump is compressed or contracted the air in

the pump is forced under pressure through the pipe 31, the lower end of the pipe 34, the fitting 35, the check valve 41, the visible flow indicator 61 and the pipe 40 into the fitting 22. As the air enters the fitting it mixes with the material in transit through the pipe system 5. The percentage or proportion of air is always constant for, as heretofore pointed out, any increase in the rate of flow of the material through the pipe system 5 results in increased actuation of the pump 8 and any decrease of the rate of flow of the material results in decreased actuation of the bellows type pump. In the event that it is desired to change the percentage or proportion of air the crank pin 55 of the crank 43 is adjusted outwards or inwards, depending upon whether it is desired to increase or decrease the amount of air. If it is desired to change the rate of flow of the material through the pipe system 5 the valve 26 is opened or closed, depending upon whether it is desired to decrease or increase the rate of flow.

The herein described mixing apparatus may be manufactured at a comparatively low and reasonable cost due to its simplicity of design, and is characterized by the fact that the percentage or proportion of air to the material is constant or uniform regardless of any rate of flow of the material in transit through the pipe system 5. By employing a bellows type pump as a medium for pumping or introducing air into the material in the pipe system the air is not subjected to lubricating oil or other foreign particles and hence enters the material without likelihood of contaminating the latter.

Whereas the apparatus has been described as being primarily or particularly designed for introducing air into congealable liquid material such as lard or vegetable oil shortening it is to be understood that it may be used to mix other gases and liquids.

It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A mixing apparatus comprising a pipe system having one end thereof connected to a source of congealable liquid, a power driven pump included in said pipe system and adapted during drive thereof to draw liquid through said one end of the system and discharge it under pressure through the other end, an air pump having a discharge connection leading to, and communicating with, the pipe system at a point between the first mentioned pump and the liquid source, and adapted during actuation thereof to introduce air into the liquid as the latter flows to said first mentioned pump, and a rotary device in the form of a gear pump connected to, and forming a part of, said other end of the pipe system and having the rotor thereof arranged to be driven by the mixture of air and liquid in transit through said other end of the pipe system and connected to actuate the air pump.

2. A mixing apparatus comprising a pipe system having one end thereof connected to a source of congealable liquid, a power driven pump included in said pipe system and adapted during drive thereof to draw liquid from the source through said one end of the system and discharge it under pressure through the other end, an air pump having a discharge connection leading to, and communicating with, the pipe system at a point between the first mentioned pump and the liquid source, and adapted during actuation thereof to introduce air into the liquid as the latter flows to said first mentioned pump, and a meter type device included in, and forming a part of, said other end of the pipe system, adapted to have the mixture of liquid and air pass there-through, operatively connected to the air pump so that it actuates the latter proportionately to the rate of flow of the mixture through the device, and arranged and constructed so that it serves intimately to mix the liquid and air as the mixture flows through it.

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