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2,887,305

INSTALLATION FOR CONTINUOUSLY MIXING A POWDERY MATERIAL
WITH A VISCOUS LIQUID, IN PARTICULAR
MEAL WITH MOLASSES

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2 Sheets-Sheet 1

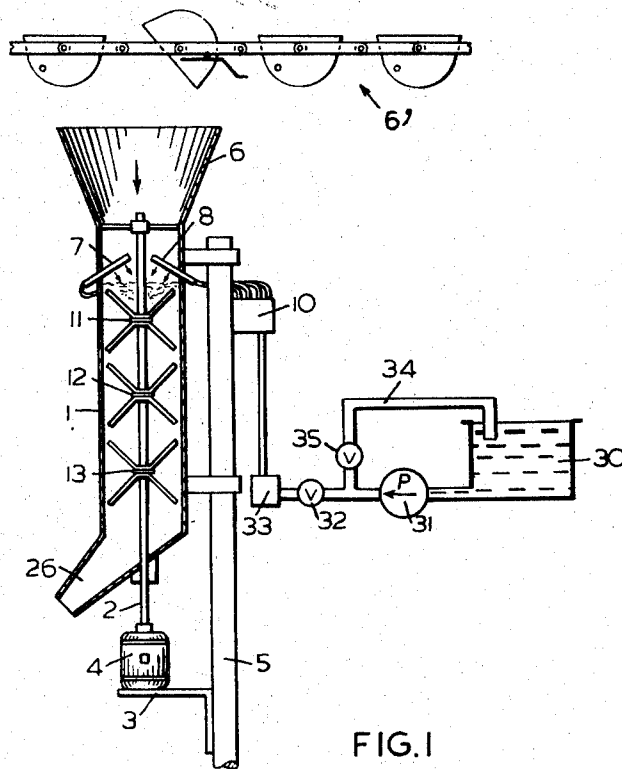


FIG. 1

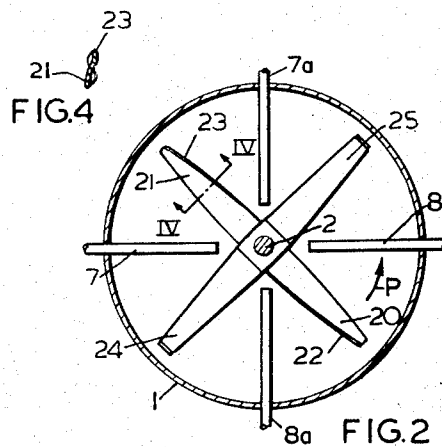


FIG. 2

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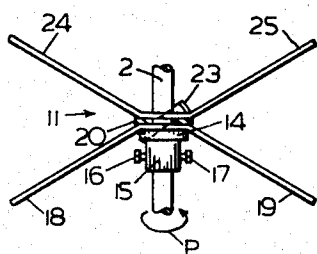


FIG. 3

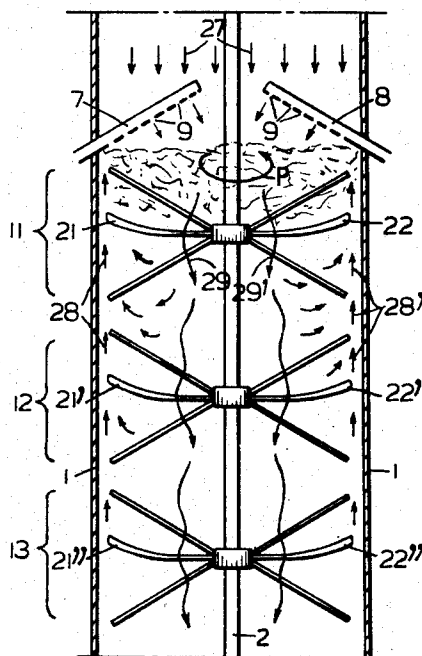


FIG. 5

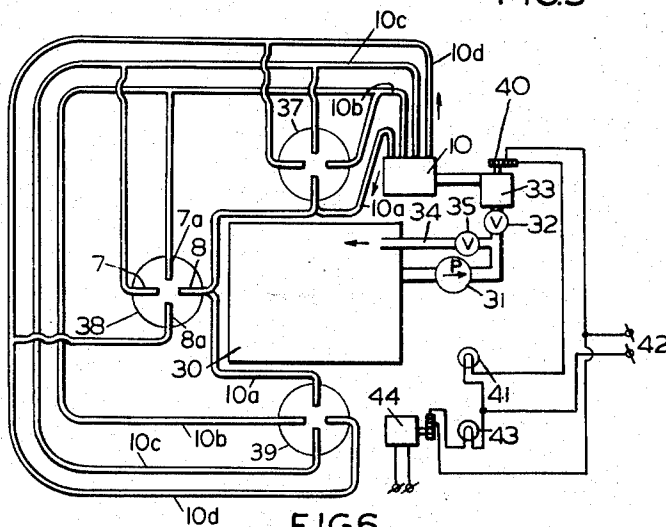


FIG. 6

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INSTALLATION FOR CONTINUOUSLY MIXING A POWDERY MATERIAL WITH A VISCOUS LIQUID, IN PARTICULAR MEAL WITH MOLASSES

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8 Claims. (Cl. 259—24)

The invention relates to an apparatus for continuously mixing a powdery solid material, in particular a meal, with a viscous liquid, in particular molasses, and an apparatus suitable for controlling and adjusting the quantity of liquid supplied per time unit.

The mixing of viscous liquids, such as molasses with dry powdery matter such as meal, meets many difficulties in practice, as lumps are easily formed. Although these lumps may be reduced, it is impossible to obtain in this way a uniform distribution throughout the mass, as appears from the fact that the final product contains loose meal powder as well as portions containing too high a percentage of the added liquid.

To prevent the necessity of kneading the meal through the molasses or to facilitate kneading, it has already been suggested to thin the molasses by preheating, for instance to 60° C. However, this not only makes it necessary to provide an additional heating device, but in addition thereto, the obtained results are unsatisfactory and the heating to a high temperature reduces the quality of the feed.

It is an object of the invention to avoid these difficulties and to provide an installation by which a uniform mixture of a powdery matter and a viscous liquid may be obtained, which may be delivered in bags like ordinary meal and wherein the mixing ratio may be exactly controlled.

In the apparatus of the invention the liquid is supplied in the form of fine jets into the upper end of a mixing chamber, to which the powdery matter is supplied at the same end, and, immediately under the supply of the viscous liquid, the powdery matter is brought in a strong rotating motion perpendicular to the direction of flow of the liquid by means of a plurality of successive assemblies of quickly rotating knives, whereby the mass slowly moves along a spirally-formed path in a downward direction and is intersected by successive assemblies of quickly rotating knives.

Surprisingly it has been found that in this manner an excellent uniform mixture may be obtained even at percentages of 40% molasses in the final product and without the necessity of any preliminary treatment such as preheating of the molasses. The final product has retained the properties of a meal, and does not stick or clot so that it may be transported as ordinary meal and may be easily and directly mixed, for instance in liquid pig's feed.

The device is characterized by the fact that pipes with fine openings for the liquid supply are provided on the upper end of a cylindrical falling chamber, said pipes being situated underneath a supply funnel for the powdery material and equally distributed over the section of the falling chamber, and the said falling chamber being provided with a central shaft with a plurality of knife-assemblies, succeeding each other in downward direction crossing the mixing chamber transversally, and at least partly forming vanes, which cause an upward flow.

With such a device of small dimensions a compara-

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tively large continuous production may be obtained. Preferably, use is made of an adjusting- and checking method for the quantity of liquid to be mixed with the powdery material, which is characterised by a relay, which operates a signal after equal but adjustable time intervals, while the quantity of liquid passing the supply conduit is indicated by a volume measuring apparatus, which also operates a signal for each passing volume unit, and the flow of liquid is adjusted in such manner that both indicators are in synchronism and the signals are operated simultaneously upon the passage of the desired quantity of liquid per time unit. The adjustment of a larger or smaller quantity of liquid to be supplied per time unit is obtained, by firstly adjusting the time relay to a smaller or larger time interval between two successive signals, in which it is desired to supply the quantity of liquid passing between two successive signals of the liquid measuring apparatus, and further by adjusting the liquid supply in such manner that the liquid signal generator is again in synchronism with the time signal generator.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the drawings in which:

Figure 1 is a general view of the installation, in which a vertical section of the mixing chamber is shown;

Figure 2 shows a top view of the mixing device on a larger scale;

Figure 3 is a corresponding side view of a knife-assembly with a section of one of the knives;

Figure 4 is a section, along the line IV—IV of Fig. 2, of the knife shown in section in Fig. 3;

Figure 5 is a schematical longitudinal section of the mixing chamber from which the operation thereof may be understood;

Figure 6 is a schematical top view of an installation with a plurality of mixing devices and with a checking device for adjusting the mixing ratio.

In Fig. 1 a cylindrical mixing device or chamber is indicated by 1. This device is provided with a central shaft 2, which is driven by an electromotor 4, which is vertically mounted on a plate 3 underneath the mixing device 1.

The plate 3 and the mixing device 1 are carried by a support 5, which may, of course, be replaced by any other desired supporting structure.

Hereinafter, the device will be described as applied to the mixing of meal with molasses, as the device is especially suitable to solve the difficulties occurring therewith.

The meal is supplied through a funnel 6, into which meal is poured, for instance from a meal storage on a higher floor, or from a conveyer 6'. By using a tray carrying conveyer 6', moving with a uniform velocity, it is easily possible to keep the supply constantly at a predetermined amount per time unit.

Underneath the funnel 6, four pipes spaced at equal distances project inwardly through the wall of the cylinder. Two of these pipes are indicated by 7 and 8 and the other two pipes are designated 7a and 8a, as seen in Fig. 2. Each of these pipes is provided on its lower side with a series of small openings 9 (Fig. 5) through which the liquid, supplied from a distributor or distributing head 10 to the pipes, enters the mixing chamber within the cylinder 1 in the form of a plurality of small jets.

These pipes extend through the wall of the mixing chamber and are upwardly inclined, so that after the supply is cut off the flow through the openings is restricted as much as possible.

On the shaft 1, three knife-assemblies 11, 12, 13 are fitted, the shape of which is clearly shown in Figs. 2-4. Two knives or fins 18, 19 are fitted to the collar 14 of a

sleeve 15, which may be fixed to the shaft 2 by means of bolts 16, 17. The knives 18, 19 are bent down under an angle of about 30°, so that they are downwardly inclined. These fins are manufactured from a continuous flat metal strip, which is provided with an opening in the center, through which the shaft 2 may pass, and which is welded to the collar 14.

Similarly a pair of knives 20, 21 has been arranged at right angles with the vertical plane through the knives 18, 19. These knives 20, 21 are positioned in a horizontal plane, but each of them is screw-shaped, as indicated by the bent edges 22 and 23 respectively, so that on rotation in the direction of the arrow P, they cause an upwardly directed air flow.

Similarly two additional knives, 24, 25 are fitted thereto, which form the image of the knives 18 and 19 and are positioned in the same vertical plane.

The sleeve 15 is slidingly and fixably carried by the shaft, as the maximum result depends on the mutual distance between the knife-assemblies.

After the exact adjustment has been found, the knife-assemblies may be definitely fixed to the shaft.

The cylinder 1, which surrounds the mixing or falling chamber is provided with an exhaust opening 26 for the final product at the side of the lower end.

Perhaps the good result of the installation may be explained by the following theory which relates to Fig. 5, although possibly also other effects may occur which contribute to the good result.

In Fig. 5, each assembly is shown with the horizontal knives between the upwardly and downwardly inclined knives, although in reality they are positioned at right angles with the plane through the latter.

These horizontal knives 21, 22, 21', 22' and 21'', 22'' mainly cause an air flow in an upward direction, and they also contribute to the function of the upwardly and downwardly inclined knives which upon rotation of the shaft 2 bring the meal supplied at 27 in a strongly rotating motion, mainly in a horizontal plane. Consequently, a rotating suspended meal cloud is formed underneath the supply openings for the molasses in the pipes 7, 8. The rotating motion will also be imparted to the jets of molasses, which flow, for instance, from the openings in each pipe, and consequently from forty openings in total. By this motion the jets are strongly stretched and form very thin threads or even a series of fine drops. These threads or drops enter the meal cloud as a band of extremely fine threads, divided over the total section of the mixing vessel and moving along spirals. Here they are immediately covered and surrounded by the meal, so that they do not come together, and no clots are formed.

The stream of air mixed with meal, which moves upwardly along the walls, indicated by the arrows 28, 28' also prevents the molasses from being deposited on the cylinder wall 1.

The molasses particles on which the meal has been deposited are heavier than the loose meal and consequently they move slowly downwardly along spiral paths. In practice, the form and the number of the knife-assemblies are also preferably chosen in such a relation to the velocity of rotation of the shaft 2, that if the meal supply is stopped after a predetermined amount of meal has been admitted, this meal is kept entirely in suspended condition and no meal flows through the outlet 26, when no molasses is supplied.

The arrows 29, 29' indicate that the molasses particles which are covered with meal and which move downwardly along a spiral path cross the path of the rapidly rotating knives and, if they still contain longer threads, are consequently divided and crumbled whereby the cutting surfaces are immediately recovered with meal. The bigger particles are most easily removed along the downwardly or upwardly inclined fins of the knives and enter again in the upwardly directed air stream 28, 28',

so that they pass the same knife-assembly again and are further reduced.

The smaller parts pass the next knife-assemblies, possibly after having been carried back one or more times along the wall. The upwardly and downwardly inclined rotating knives in the falling chamber contribute strongly along the total length of the mixing cylinder to the maintenance of a rotating motion of the whole mass, so that the particles will cover a long path through the falling chamber and all the loose meal will come into contact with molasses, and the material remains finely grained. It has been found that the molasses is deposited neither on the wall, nor on the knives.

In this way it has been found possible to mix in a perfectly uniform way 2½ tons of meal per hour with molasses in a cylinder 1 with a diameter of about 25 cm. and a height of about 100 cm. when the shaft 2 rotates with a velocity of about 3000 r.p.m., while the distance between the ends of the inclined knives of each two successive knife-assemblies amounts to about 7 cm.

In preparing a mixture with about 12% molasses, which is a very desirable mixture in practice, it has been found that a non gluey meal is obtained, which may be transported in bags like loose meal and which distinguishes itself from pure meal only by its brownish color. It has been found that the molasses is so finely divided that even the grains sieved through the finest meal sieves still have a brownish color and contain the required percentage of molasses.

It has been found possible to make a uniform mixture of meal and molasses with 40% molasses which may be transported and treated like meal without any formation of lumps or inadmissible gluing.

Moreover an important simplification is obtained as the molasses may be worked in cold, and consequently very viscous, condition, so that no preheating will be necessary.

Fig. 1 shows that the molasses is placed in a reservoir 30, to which a pump 31 is fitted, which brings the liquid via a regulating valve 32 and a volume measuring apparatus 33 to a distributing head 10 for the supply conduits to the pipes 7, 8, 7a and 8a in the mixing vessel 1.

The quantity of molasses, which is supplied to the mixing vessel 1 by the pump is further adjusted by means of a return or short-circuit conduit 34 with a valve 35, which returns the excess liquid to the reservoir 30. It is now possible to regulate the flow by adjusting the valves 32 and/or 35.

If it is desired to attain a larger total capacity with the aid of normal mixing devices, an arrangement according to Fig. 6 may be used, wherein vertical cylindrical mixing cylinders or chambers 37, 38, 39 are placed on three sides of the square central liquid reservoir or tank 30 while the pump and the supply or distributing devices are placed along the fourth side. In this arrangement distributor 10 has four effluent conduits 10a, 10b, 10c and 10d, each of these conduits supplying one of the pipes of the three tanks 37, 38 and 39.

It is very important that the mixing ratio may be continuously checked in an easy way. For this purpose the embodiment of Fig. 6, may be used, wherein the shaft of the rotating liquid measuring apparatus 33, whose number of revolutions is proportional with the passed volume of liquid, drives a relay-contact 40, which operates a signal device 41 after each revolution, i.e. each time a predetermined volume has passed. In this embodiment, 41 is an electric lamp, for which a circuit connected with a source of current at 42, is shortly closed by means of the relay 40. Furthermore a second signal lamp 43 is included in an electric circuit, which is periodically closed after equal, but adjustable time intervals by means of a timing relay 44.

The time interval between two successive signals is adjusted by means of this timing relay to correspond

with the time in which the volume measuring device 33 is to make one revolution, or, in other words, in which a predetermined quantity of liquid passes.

The valves 32 and 35 are then adjusted in such manner that the volume measuring device 33 runs synchronously with the timing relay, so that the lamps 41 and 43 are simultaneously lighted each time.

A retardation or acceleration of the volume measuring apparatus will be immediately visible from a lagging or a leading of signal 41 with respect to signal 43.

If it is desired to mix, for instance, the double quantity of molasses with the quantity of meal which is constantly supplied per time unit the timing relay will be adjusted to run twice as fast and the assemblies 32 and 35 are again adjusted until the volume measuring apparatus runs synchronously. The obtained meal with a percentage of molasses may also be used directly for pressing feeding cakes if this kind of feed is desired.

Special mixing- and kneading devices at the cake press will then become superfluous and a completely uniform distribution of the molasses in each cake as well as an equal percentage of molasses in all the cakes is completely assured.

I claim:

1. A device for continuously mixing a powdery solid material with a viscous liquid comprising a square liquid tank, a pump and a liquid distributing means arranged opposite one side of said liquid tank, said pump being in fluid-communicating relationship with said tank and with said liquid distributing means, three vertical cylindrical mixing chambers each arranged opposite one of the three other sides of said liquid tank and each comprising a plurality of pipes extending through the wall of the mixing chamber at its upper end, equally distributed over the section of the mixing chamber and each provided with a plurality of fine outlet openings, said distributing means being in fluid-communicating relationship with said pipes, a supply funnel for the powdery material extending into each mixing chamber at its upper end, a central shaft mounted in each mixing chamber, a plurality of knife-assemblies fitted to said shaft, one above the other, each having a plurality of at least partially vane-shaped knives crossing the mixing chamber transversally, and means for rotating said shaft.

2. A device according to claim 1 wherein said liquid distributing means comprise a distributing head and a conduit connecting said pump with a distributing head, a regulating valve fitted to said conduit, a volume measuring apparatus fitted to said conduit, a plurality of supply conduits connecting said distributing head to each of said chambers and a short circuit conduit connecting the pump to the liquid tank.

3. A device for continuously mixing a powdery solid material with a viscous liquid comprising a vertical mixing chamber, a plurality of pipes extending through the wall of said mixing chamber at its upper end equally distributed over the cross section of said mixing chamber and each provided with a plurality of fine outlet openings positioned to discharge a plurality of downwardly-directed elongated streams of liquid substantially across the entire diameter of said chamber, a liquid supply source connected to said pipes, a supply funnel for the powdery material extending into said mixing chamber at its upper end above said pipes to supply said powdery material axially to said chamber, a central shaft mounted in said mixing chamber, a plurality of knife-assemblies mounted on said shaft one above the other in vertically spaced relationship, each of said assemblies having a plurality of at least partially vane-shaped knives extending across said mixing chamber and being adapted to generate an upwardly directed air-flow, and means for rotating said shaft with sufficient velocity that the resultant upwardly directed air flow will keep the powdery solid material in suspended condition until mixed with the viscous liquid and said elongated streams of liquid and the elongated drops therein will be continuously cut by said knives.

gated streams of liquid and the elongated drops therein will be continuously cut by said knives.

4. A device according to claim 3 wherein each knife-assembly has at least one upwardly directed knife and at least one downwardly directed knife.

5. A device according to claim 4, wherein at least one horizontal knife is placed between said upwardly directed and said downwardly directed knife.

6. A device according to claim 5 wherein the upwardly and downwardly inclined knives are placed at angles of approximately 30 degrees with respect to the horizontal plane.

7. A device for continuously mixing a powdery solid material with a viscous liquid comprising a vertical mixing chamber, a plurality of pipes extending through the wall of said mixing chamber at its upper end equally distributed over the cross section of said mixing chamber and each provided with a plurality of fine outlet openings positioned to discharge a plurality of downwardly-directed elongated streams of liquid substantially across the entire diameter of said chamber, a liquid supply source connected to said pipes, a supply funnel for the powdery material extending into said mixing chamber at its upper end above said pipes to supply said powdery material axially to said chamber, a central shaft mounted in said mixing chamber, a plurality of knife-assemblies mounted on said shaft one above the other in vertically spaced relationship, each knife-assembly comprising two upwardly directed knives lying in a vertical plane symmetrically with respect to said shaft, two downwardly directed knives lying in the same vertical plane symmetrically with respect to said shaft and two substantially horizontal vane-shaped knives lying in a second vertical plane perpendicular to said first-mentioned plane, said vane-shaped knives being adapted to generate an upwardly directed air flow, and means for rotating said shaft with sufficient velocity that the resultant upwardly directed air flow will keep the said powdery solid material in suspended condition until mixed with said viscous liquid and said elongated streams of liquid and the elongated drops therein will be continuously cut by said knives.

8. A device for continuously mixing a powdery solid material with a viscous liquid comprising a vertical mixing chamber, liquid supply means at the upper end of said mixing chamber and equally distributed over the cross section of said mixing chamber to discharge a plurality of downwardly-directed elongated streams of liquid substantially across the entire diameter of said chamber, a liquid supply source connected to said liquid supply means, a supply funnel for the powdery material extending into said mixing chamber at its upper end above said liquid supply means to supply said powdery material axially to said chamber, a central shaft mounted in said mixing chamber, a plurality of knife-assemblies mounted on said shaft one above the other in vertically spaced relationship, each of said assemblies having a plurality of at least partially vane-shaped knives extending across said mixing chamber and being adapted to generate an upwardly directed air-flow, and means for rotating said shaft with sufficient velocity that the resultant upwardly directed air flow will keep the powdery solid material in suspended condition until mixed with the viscous liquid and said elongated streams of liquid and the elongated drops therein will be continuously cut by said knives.

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