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(54) Benævnelse: **Fremgangsmåde til styring og overvågning af en automatiseret smørfremstillingsproces**

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METHOD FOR CONTROLLING AND MONITORING AN AUTOMATIZED BUTTERMAKING PROCESS

Description

The invention describes a butter making process according to the preamble of claim 1.

US 2,630,059 and DD 264 836 are cited as prior art.

A method according to the preamble of claim 1 is known from DE 3039807.

In the field of industrial butter making methods, continuous butter making with a machine of Dr. Fritz has been established since 1941. Thanks to this machine and the corresponding method, a good and uniform quality of butter is assured with little loss of fat.

On the basis of the Fritz/Eisenreich method, the process steps of butter formation, after-churning, separation of buttermilk, kneading of the butter and blending of additives are automated. The processes of churning and after-churning by churning drums and the separation of buttermilk as well as the kneading of the butter mass by texturizers have been provided with motorized worm drives.

However, the technical implementation shows the problem that the transition between after-churning drum and texturizer, where the separation of the buttermilk occurs, sometimes gets clogged with butter grain, which can result in a drop in production or even a temporary stoppage of the butter making machine.

The prevention of deposits at the transition from the after-churning drum to the texturizer constitutes a central problem, since they depend on many factors which are dictated primarily by the cream as starting material and the processing thereof. These factors include the butterfat content, the length and temperature of the cream ripening, the cream temperature, the cream arrival times and the desired butter quality.

Thus far visual monitoring has been done by a viewing port or a camera arranged on the inside of the after-churning drum and it has required the constant attendance of a worker to watch the process of transfer of the butter grain/buttermilk mixture from the drum to the texturizer.

These variable cream properties result in different butter grain consistencies in the after-churning process. Thus, large chunks of butter or rolls indicate an over-churning by too much water uptake on account of too fast a turning speed of the beater. An underchurning shows itself by a soft mass, which in turn indicates too low a turning speed. While overchurning can be corrected, an underchurning leads to derailment of the process.

Therefore, the invention sets itself the problem, starting from the existing method, to lessen the tendency to form deposits and at the same time to ensure a long-lasting and trouble-free operation of the butter making machine with optimal churning.

The invention solves the problem with the features of claim 1.

Accordingly, butter is produced in a churning machine which has at least one inlet (1) into a churning cylinder (2) with a beater (3), a rotatable after-churning drum (5), a texturizer (6) and an outlet.

The method of production of butter comprises the following steps:

a. supplied cream is converted in the churning cylinder (2) into butter grains and butter milk by means of a beater (3);

b. the butter grain size is checked in an after-churning process in the after-churning drum (5);

c. the butter grain/butter milk mixture is transferred into a texturizer (6); and

d. the butter milk is separated from the butter grains by means of a texturizer (6) and then the butter grains are converted into a butter mass;

wherein

e. the current consumption for operating the after-churning drum (5) is measured in step b., and/or the current consumption for operating the texturizer (6) is measured in step d., and

f. the transfer from step b. to step c. is monitored, controlled and regulated depending on the measurement in step e.

Advantageous embodiments of the invention will be found in the subclaims.

The optimization of the churning can be well controlled by monitoring the alternating current consumption during the after-churning phase.

Thus, an underchurning, due to the larger quantity (phase conversion not optimal, soft butter grain with cream and some buttermilk) leads to an increased current consumption, which can be detected by sensors during the after-churning.

In the case of overchurning, due to the increased incorporation of buttermilk there is a formation of a butter roll. This can at times block a shaft serving to take the butter grain from the after-churning drum to a first texturizer. The resulting increased current consumption at the texturizer motor can be detected according to the invention in conjunction with the current consumption at the after-churning motor, evaluated, and used for counteracting measures when the deviations are great, as in the case of a blocking of the texturizer.

In one advantageous embodiment of the invention, the butter grains are cooled by a cooling section. The cooling is done between the churning and the after-churning, in order to give the butter grain a harder consistency and enable an easier adjustment of the optimal butter grain size in the after-churning process.

The butter grains are taken from the after-churning process, with drainage of the buttermilk, to a texturizer, which kneads the butter grain with the aid of a worm drive, frees it from buttermilk residue and homogenizes it in regard to the water distribution.

Furthermore, a blending of additives is desirable after the separation of the cream into butter grain and buttermilk by another texturizer. Taste and appearance of the product can be varied in this step. The required additives for this can be worked rather easily into the butter as a result of the homogenization.

In one advantageous variant of the method, air inclusions are sucked out from the product in a vacuum, in order to improve the shelf life of the butter.

In order to perform a final fine tuning of the consistency as well as the water content in the butter, a further texturizer and a mixing zone for the water dosage are provided advantageously after the vacuum zone.

The finished butter can now be taken out from the machine by an ejector pump.

For the automating of the after-churning, the corresponding drum is advantageously motor-operated, which furthermore affords the opportunity of measuring a process variable. For this, the current consumption of the drive unit of the after-churning drum or the following texturizer can be determined. One can assign a normal value of the current consumption for optimal churning. If the current consumption so determined differs from this normal value, a difference current can be detected based on the fluctuation differences, which can be used as a metered variable for control of the churning process, in order to counteract these fluctuations appropriately.

Optical control by means of a viewing port in the wall of the after-churning drum creates the advantage of an optical monitoring, besides the possibility of metered monitoring or process or product dependent variables.

In the case of overchurning, a butter roll is formed due to inclusion of buttermilk. Less buttermilk is therefore drained. At the after-churning drum it is possible to detect a slight current consumption. Preferably, however, the current consumption of a drive unit of the texturizer is used as a metered value and indicator during the control and regulation of the churning process. Large butter clumps can cause a clogging or blocking of the shaft transferring the butter grain (in step c.). Thus, the after-churning drum is mechanically braked by the butter, which in the long run leads to machine damage.

One means of preventing this is to stop the arrival of cream upon reaching a maximum value of the current consumption at the after-churning drum.

During an overchurning, one detects a crossing of the limit value of the current consumption of the drive unit in the texturizer. After this, the worm speed is increased by preferably at least 10%. This is of advantage, because the after-churning drum is emptied more quickly in this way and a blocking of the shaft between after-churning drum and texturizer is prevented. In order to bring about a change in the worm speed of the texturizer by preferably at least 10%, there must be an increase in the current consumption of preferably at least 5% of the normal value.

At the same time, the beater speed of the churning cylinder is lowered by preferably 2%. After 5 min the worm speed can be regulated back, while the beater keeps its reduced speed.

In another advisable process variant, an exceeding of the limit value of the current consumption of the drive unit of the after-churning drum leads to a throttling or stoppage of arrival of the incoming cream amount. Advantageous here is the fact that no deposits can form as a result of congestion.

During underchurning there is likewise an exceeding of the limit value of the current consumption of the drive unit of the after-churning drum, which can be counteracted by an increasing of the beater speed of the churning cylinder by preferably at least 2%, since the resulting altered butter grain size ensures a better transfer of the butter grain/buttermilk mixture.

The beater only needs to be operated for a short time, such as 5 min, with increased beater speed, until a restoration of the normal value has occurred.

In one advantageous variant embodiment of the invention, sensors coupled to a control unit monitor the current consumption of the drive unit of the after-churning and can respond accordingly to changes in the current consumption. This technique of metering and control enables an uncomplicated and also a timely monitoring of the production process.

A sample embodiment of the invention will now be explained with the aid of the enclosed drawings. Furthermore, figures are given to illustrate the solution of the problem.

There are shown:

Fig.1, a schematic representation of a butter making machine, which is operated by the Fritz/Eisenreich method,

Fig.2, a more detailed representation of a butter making machine with various sections of the machine and various possibilities for regulation and control,

Fig.3a, a schematic view of a churning drum during the after-churning of the butter grain in the case of underchurning,

Fig.3b, a schematic view of a churning drum during the after-churning of the butter grain in the case of normal churning,

Fig.3c, a schematic view of a churning drum during the after-churning of the butter grain in the case of overchurning (3c).

Fig. 1 shows a butter making machine, having an inlet 1 for cream, as well as a churning cylinder 2, in which a rotationally arranged beater 3 is located, for the formation of butter grains and buttermilk from supplied cream.

In a cooling section 4 the butter grain is given a harder consistency and can then be better worked.

In an after-churning drum 5, the optimal butter grain size is adjusted in the after-churning process. The butter grain is then transferred via a shaft 17 to a texturizer 6.

The texturizer 6 changes the butter grain into a homogeneous “water in oil emulsion” and at the same times frees the butter of buttermilk residue, which is then taken away.

In a mixing zone 7, water, acid concentrates and brine are added to the butter in order to optimize the flavour and consistency of the butter.

In a vacuum chamber 8, air is removed from the butter to increase its shelf life.

Another texturizer 9, along with a subsequent mixing zone 10, ensures a uniform distribution of the water content in the butter and an optimizing of the water content.

With an ejector pump 11, the finished butter is discharged from the machine.

As is shown in Fig. 2, the after-churning drum 5 is driven by a drive unit 12 and a beater 3 of the churning cylinder 2 by a drive unit 13.

The current consumption of the drive units 12 and 16 can be monitored by the sensors of a measuring and control unit 15. Furthermore, an optical checking of the after-churning can be done through a viewing port 14.

With the aid of the more detailed representation of Fig. 2, the issues of the churning process and the possibilities of influencing it shall now be described. If there is an underchurning, that is, a power increase due to too little buttermilk drainage in the after-churning drum 5, there will be a fluctuation in the current consumption in a certain difference range. The same applies to overchurning. Here again, as in the case of underchurning, there will also be fluctuations in the current consumption at the texturizer 6.

If the current consumption rises in both instances above a defined limit value (normal consumption + differential consumption), various actions should be taken to counteract this deviation from the normal case.

These include:

- an increasing of the worm speed in the texturizer 6;
- a shutoff of the inflow of cream;
- a changing of the beater rate in the churning cylinder 2;

Fig. 3a shows an underchurning from the viewing port perspective 14 in the after-churning drum 5. Fig. 3b shows a view of the optimal churning and in Fig. 3c one notices the formation of a butter roll as an effect of overchurning. The speed of the beater 3 in the churning cylinder 2 for the most part determines the grain size of the butter grain. In the optimal case, this is as big as one’s fist.

Reference symbols

Inlet	1
Churning cylinder	2
Beater	3
Cooling section	4
After-churning drum	5
Texturizer	6
Mixing zone	7
Vacuum chamber	8
Texturizer	9
Mixing zone	10
Ejector pump	11
Drive	12
Drive	13
Viewing port	14
Measuring and control unit	15
Drive	16
Shaft	17

Patentkrav

1. Fremgangsmåde til fremstilling af smør i en kærnemaskine, som har mindst et indløb (1) til en kærnecylinder (2) med en pisker (3), og har en roterbar efterkærnetromle (5), en udpresser (6) og et udløb, med følgende trin:

a. tilført fløde forvandles i kærnecylinderen (2) til smørkorn og kærnemælk ved hjælp af en pisker (3),

b. smørkornenes størrelse kontrolleres i en efterkærningsproces i efterkærnetromlen (5),

c. smørkorn/kærnemælk overføres til en udpresser (6), og

d. kærnemælken udskilles fra smørkornene ved hjælp af en udpresser (6), og smørkornene forvandles derefter til en smørmasse,

kendetegnet ved, at

e. strømforbruget til drift af efterkærnetromlen (5) måles i trin b., og/eller strømforbruget til drift af udpresseren (6) måles i trin d., og

f. overførslen fra trin b. til trin c. overvåges, styres og reguleres i afhængighed af målingen i trin e.

2. Fremgangsmåde ifølge foregående krav, **kendetegnet ved, at** smørkornene afkøles mellem trin a. og trin b. med en kølesektion (4).

3. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** additiver doseres og iblandes via en blandezone (7) i tilslutning til udpresseren (6).

4. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** luft kan fjernes fra smørmassen via en vakuumzone (8) i tilslutning til en blandezone (7).

5. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** præcis justering af produktets konsistens og også af dets vandindhold foretages af en yderligere udpresser (9) og en yderligere blandezone (10) i tilslutning til en vakuumzone (8).

6. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** den færdige smørmasse udledes med en ejektorpumpe (11) i tilslutning til en blandezone (10).

7. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** efterkærnetromlen (5) roteres af et drev (12), og kærnecylinderens (2) pisker (3) roteres af et drev (13), og at drevets (12) og/eller drevets (16) strømforbrug måles, og den differencestrøm, som forekommer, anvendes som målevariabel i tilfælde af en afvigelse fra standardværdien.

8. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** yderligere optisk kontrol af kærneprocessen i efterkærnetromlen (5) sker via inspektionsvinduer (14).

9. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** når grænseværdien af drevets (16) strømforbrug i trin d. overskrides med mere end 5%, øges udpresserens (6) snekkeomdrejningstal med mindst 10% som modforholdsregel.

10. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** når grænseværdien af strømforbruget i trin b. og/eller i trin d. overskrides, neddrosler eller standser kærnemaskinen tilførslen af fløde ved indløbet (1) som modforholdsregel.

11. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** når grænseværdien af strømforbruget i trin b. og/eller i trin d. overskrides, øges piskehastigheden af kærnecylinderens (2) pisker (3) med mindst 2% som modforholdsregel.

12. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** strømforbruget overvåges i trin b. af et følerarrangement på drevet (12) og evalueres af en styreenhed (15) for at øge piskerens (3) piskehastighed, standse tilførslen eller øge udpresserens (6) snekkehastighed.

13. Fremgangsmåde ifølge ethvert af de foregående krav, **kendetegnet ved, at** ved en blokering af akslen (17) reduceres kærnecylinderens (2) piskehastighed, og udpresserens (6) snekkehastighed øges.

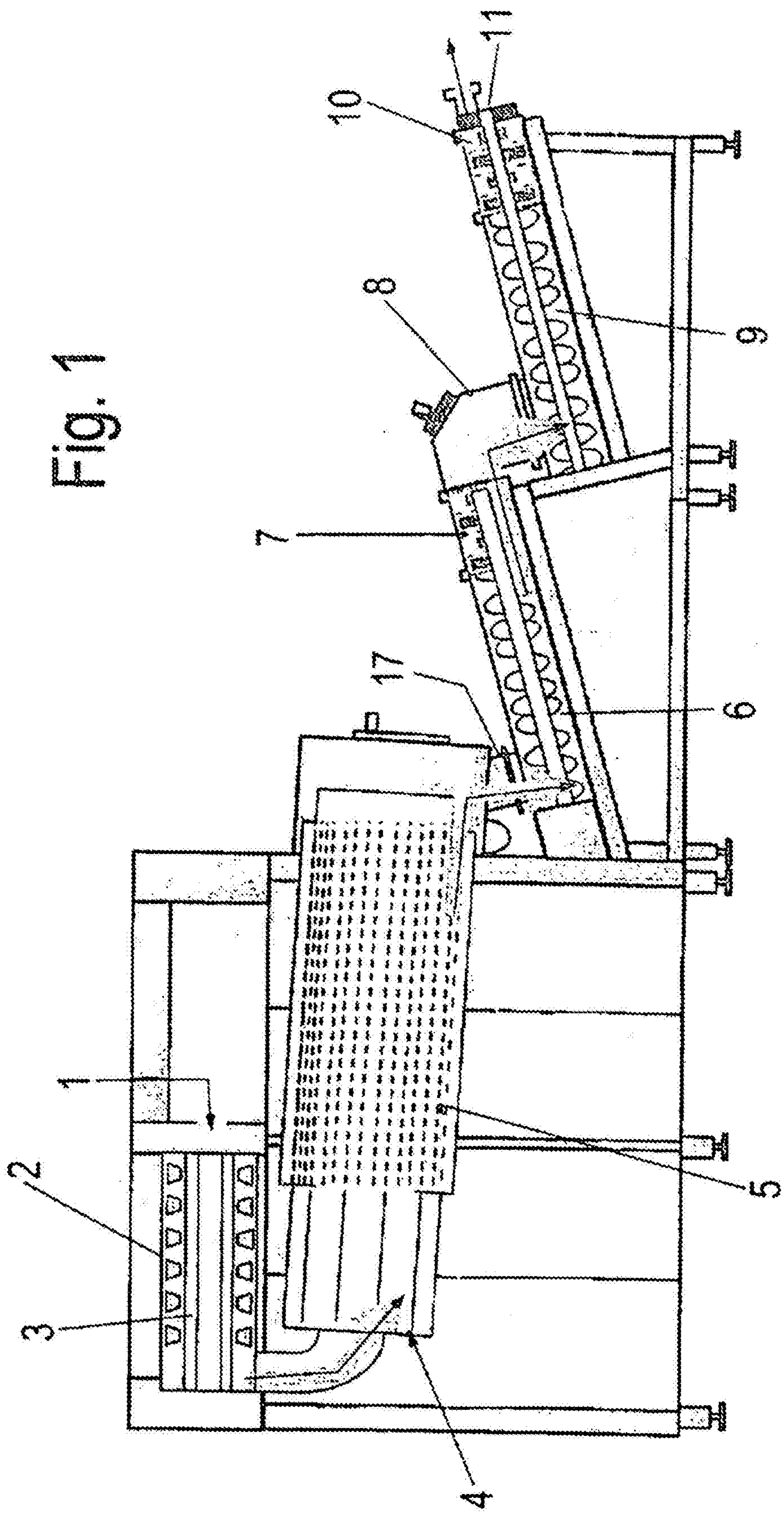


Fig. 1

Fig. 2

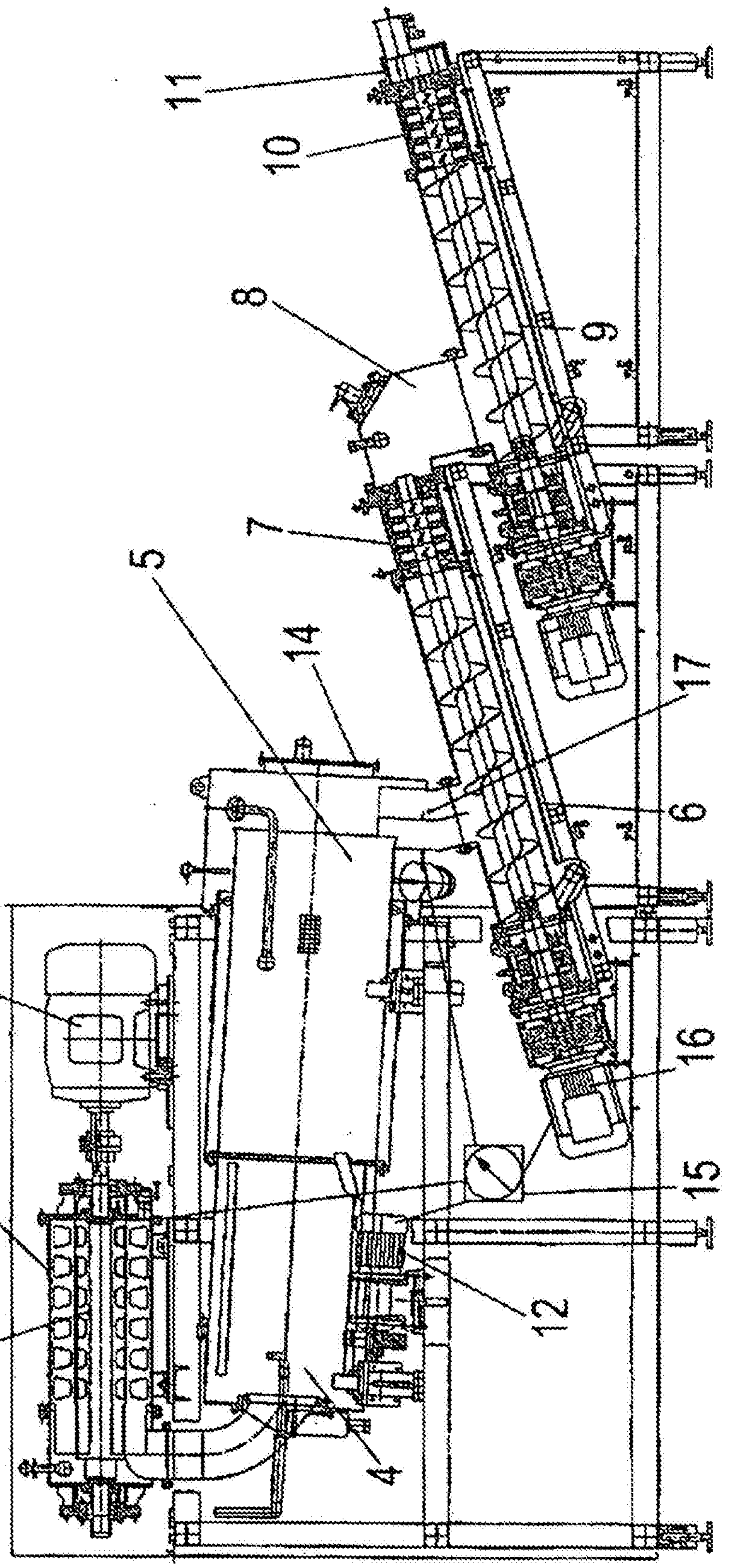
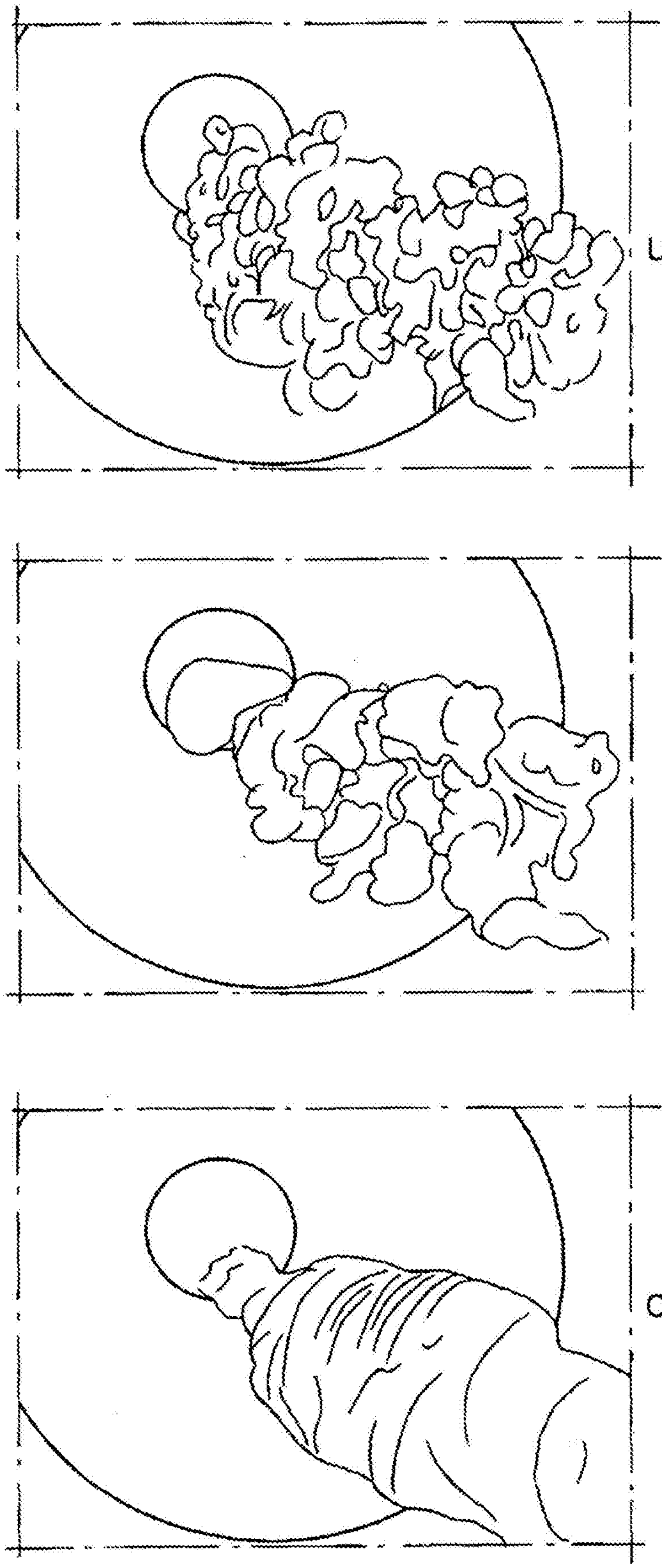


Fig. 3



underchurning

a

normal churning

b

over churning

c