Oversættelse af europæisk patentskrift

Int.Cl.: C 12 C 7/04 (2006.01) C 12 C 7/06 (2006.01) C 12 C 7/22 (2006.01) C 12 C 13/00 (2006.01) C 12 C 13/02 (2006.01) F 28 D 1/06 (2006.01) F 28 D 3/00 (2006.01) F 28 D 3/04 (2006.01) F 28 D 21/00 (2006.01) F 28 F 13/12 (2006.01)

Oversættelsen bekendtgjort den: 2015-03-09

Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: 2014-12-17

Europæisk ansøgning nr.: 11766890.5

Europæisk indleveringsdag: 2011-10-04

Den europeiske ansøgnings publiceringsdag: 2013-08-14

International ansøgning nr.: EP2011004945

Internationalt publikationsnr.: WO2012045440

Prioritet: 2010-10-04 DE 102010041956

Designerede stater: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Patenthaver: Krones AG, Boehmerrwaldstr. 5, 93073 Neutraubling, Tyskland

Opfinder: Kammerloher, Helmut, Pettenbrunn 5a, 85354 Freising, Tyskland

Fuldmaægtig i Danmark: Larsen & Birkeholm A/S Skandinavisk Patentbureau, Banegårdspladsen 1, 1570 København V, Danmark

Benævnelse: Fremgangsmåde og indretning, især til mæskning ved fremstilling af øl

Fremdragne publikationer:
WO-A1-02/12433
DE-A1-102008 056 744
DE-CI- 19 828 686
Method and device for mashing in the production of beer

The invention relates to a method for mashing in the production of beer and to a device for carrying out the method.

WO 02/12433 A1 describes a vessel for the production of beer, which can be used for mashing and wort boiling. The mash is conducted over an inclined heating surface and runs in a channel.

DE 10 2008 056 744 A1 describes a device and a method for stripping of wort wherein, with the help of a distribution device, wort is conveyed on a heating means and can run down thereon. There is described an embodiment, which uses a respective device for mashing. Then the mash is not introduced by the distribution device but by a separate inlet.

Document DE 198 28 686 C1 describes a device in which medium to be heated is solely conveyed above a heated surface in the middle of the vessel.

US 2009/0207689 A1 discloses a reactor for heating a fluid, does not however relate to a mashing device. The vessel shows a feed connection, which serves as a support for additional devices or as a connection fitting for a product inlet.

Mashing is an important process step for the production of beer. During mashing, grist and water are mixed together, and the ingredients of the malt are thereby dissolved. High-viscosity mashes, so-called thick mashes, are used for the production of wort with a high concentration (high-gravity method). Currently the mash work in the mash tun is often only possible with restrictions starting at a concentration that results in a 22% first wort (without enzymes) or a 24% first wort (with enzymes). This can also negatively affect all subsequent processes, which then either function only with restrictions or even no longer function at all.

One reason for this is, for example, the lowering of the heat transfer coefficient caused by the viscosity. For a high heat flow level, however, a high heat passage coefficient or a larger heating surface is required, but these are either difficult to influence or they are limited. At an increased heating agent temperature, it would also be possible to increase the heat flow, but this would also cause an increase in the boundary layer temperature,
one consequence of which would be damage to the enzymes. Fouling and the temperature-caused losses could furthermore also be greatly increased, as a result of which the primary energy requirements would increase. The cleaning effort would likewise increase.

A further reason is the reduced enzyme activity. In the thick mash, it is possible, e.g., for gas occlusions to remain longer and consequently to form a type of barrier between the enzymes and substrate. In addition, the increased viscosity of the mash hinders the mobility and work of the enzymes, so that the stipulated resting often no longer leads to the desired result.

A third reason can be an inhomogeneous mash that results, e.g., from gas-caused density differences and the demixing of the mash that results therefrom. The gas-tainted and lighter mash particles hereby strive more strongly towards the surface level, which often cannot be sufficiently prevented by means of the installation location of agitators close to the base. These mash particles are then possibly in the temperature optimum of the enzymes for a shorter time, which, for example, can lead to extract losses.

On this basis, the object of the present invention is to provide an improved method for mashing and a corresponding device, particularly for thick mashes, that allow gentle and energy-saving heating of the mash.

According to the invention, this object is solved by means of the features of Claims 1 and 8.

Preferred embodiments result from the dependent claims.

According to the present invention, the heating surface now extends upwards above the surface level of the mash in such a manner that the mash can run down along the heating surface until it reaches the surface level of the mash. The volume-independent heating surface enlargement consequently reduces the problem of the viscosity-caused reduction of the heat transfer in the case of more highly concentrated mashes and during the gelatinisation phase.

Due to the fact that the mash flows in a thin film downwards along the heating surface, the gas bubbles close to the surface can abruptly or very quickly enlarge and be expelled due to the temperature increase. Due to the degassing of the mash, it is
possible, e.g., to reduce gas-caused density differences of the mash substantially and to increase the enzyme activity as described above in thick mashes. Due to the fact that the mash is conveyed along the heating surface, it is also possible already to expel further unwanted volatile substances, such as, for example, dimethyl sulphide (DMS), from the mash. DMS is an organic compound that contains sulphur and that causes an off-flavour in beer. DMS arises from the precursors formed during malting, S-methylmethionine (SMM) and dimethyl sulphoxide (DMSO).

Due to the fact that the mash is additionally heated by being conveyed along the heating surface, the temperature of the heating medium can be reduced. Gentler heating of the mash is consequently possible. Due to the fact that no high heating medium temperatures are necessary, it is possible, for example, also to use thermal energy from heat recovery, i.e., to use the waste heat of other process steps (e.g., hot water that arises during the wort cooling) expeditiously for heating the heating medium and consequently for heating the mash, so that the use of primary energy for heating the mash can be prevented or at least reduced substantially. The reduced heating medium temperature, as well as the possible use of highly concentrated mashes, consequently results in substantial energy savings. By using a heating medium from heat recovery, the heating surface wall can be produced more economically. By having, e.g., a thinner heating surface wall, in turn, it is possible to improve the heat passage.

A further advantage is that, due to the innovative conducting of the mash, improved overall intermixing results, particularly also in the case of large tun diameters and high filling levels.

Due to the application of the mash onto the heating surface, which extends above the surface level, the volume flow at the mash surface increases, particularly in the case of high filling levels, which in turn reduces the density-caused mash slick that sometimes develops at the surface level and consequently in turn results in better enzyme activity and conversion of the starch in the mash.

A further advantage lies in the fact that, e.g., the mash can be heated optimally, independently of the quantity of mash, by one and the same device. There is no longer a need for specific subdivisions for the heating frame depending on the type of beer, which saves considerable costs and clarification effort during the design. New types with greatly varying quantities of mash can also be heated well with this system (large
increase in flexibility for the brewery). Even "micro" mash portions and / or "micro" mash quantities can be heated reliably and uniformly. For such cases, no additional heating base would then be necessary, because the "micro" mash portions and / or "micro" mash quantities are heated by being run down along the heating surface.

This procedure additionally allows the construction of slimmer and more favourable mash containers (with filling levels of, e.g., 3 to 5 m and container heights of 5 to 8 m). This in turn allows a very good surface area / volume ratio (A/V ratio) of the tun, whereby the radiation losses are reduced.

The distribution device and heating surface according to the invention can also easily be retrofitted into existing mashing devices, which provides the customer with a great potential for saving energy.

It is particularly advantageous that the heating surface can be heated with a heating medium that has a temperature that preferably is in a range of or that lies below its cooking temperature. The temperature of the heating medium advantageously lies 10 to 30 K above the respective product temperature, i.e., here the mash, or of the medium in the device. The reduction of the temperature, i.e., the gentle heating, reduces fouling, is gentle on the enzymes and saves energy as was already explained. Due to the reduction of the temperature of the heating medium, the frequency and / or intensity of CIP cleanings in the mash tun can be reduced, which in turn saves water, energy and cleaning agent.

According to the present invention, the mash is applied onto the heating surface in an upper area, particularly the upper quarter of the mashing device. This leads to a maximum enlargement of the heating surface and the advantages associated with this.

The mash can already be mashed into the mashing device by means of the distribution device. This means that at the beginning, the mash can already be conducted along the heating surface, where it can outgas especially effectively and quickly due to the temperature increase, so that oxygen-caused damage to the enzymes can also be prevented.

The enlargement of the mash surface during the heating has no negative influence on the oxygen pick-up, because as a result of the energy input, as already described,
adhering gas particles detach and in addition, the solubility of oxygen in water or mash is negligible at higher temperatures and approaches zero at the cooking temperature. In addition, with the energy input, the thickness of the water vapour boundary layer at the downwardly-running mash increases and functions as a barrier between the mash film and the vessel space. As a precaution, one can also supply the vessel space with gas and / or produce a negative pressure in the mashing device / mashing vessel. The device is then advantageously formed as a pressure vessel for positive pressure and vacuum. A negative pressure assists the outgassing of the mash further.

The gas used can be, for example, nitrogen or carbon dioxide, or any other gas and / or gas mixture.

When pumping out the portion of the mash, the mash is advantageously pumped out of the lower area of the mashing device, particularly from the middle base area. Advantageously, it is then possible, e.g., to pump off the mash in the tun centre with the already existing mash pump, and then to pump it upwards to the distribution device, so that no additional pump is required. Due to the addition of the pumped mash from above, the intermixing of the mash in the uppermost liquid layers consequently improves relatively independently of the mash filling level. It is advantageous, however, if the mash is additionally agitated in the lower area of the mashing device. The mash agitator, the gearbox and the drive unit can, however, then be designed more favourably.

Due to the additional provision of the agitator, there results the following movement of the mash. Due to the lift caused by the agitator and due to the thermal lift, the mash strives upwards on the inner surface of the vessel wall. Some mash particles have a lower density and strive upwards more strongly and can float there easily. Most of the mash particles migrate into the upper liquid area along the frame, then towards the centre, and from there back downwards again, whereby a portion is pumped off.

In the case of the device according to the invention, it is advantageous if the distribution device is preferably formed as an annular pipe coil or half-pipe coil with openings or with an annular gap. The openings are thereby preferably arranged uniformly around the circumference of the annular pipe or ring-shaped half-pipe coil. The mash can consequently exit from the distribution device and on to the heating surface. Due to the openings or the annular gap, there result a reduction in the cross-section of the mash
and an enlargement of the mash surface, so that gas bubbles near the surface can simply rip open.

The heater is advantageously formed in such a manner that at least one outlet for the heating medium is arranged in the upper area of the heating surface and at least one outlet is provided in the lower area of the heating surface. At least one inlet for the heating medium is provided in a middle area, between the at least one upper outlet and the at least one lower outlet. The expression middle area means between the two outlets or between the upper and lower ends of the heating surfaces. The heating medium can consequently flow upwards and downwards from the middle inlet. This has the advantage that in an upper area of the heater, the heating medium flows in a counterflow to the downwardly-flowing mash. Also in the lower area, in which the mash moves upwards on the inner wall of the vessel due to the effect of the agitator, the heating medium flows downwards in a counterflow, which clearly improves the heat flow.

In any case, the heat flow improves if the flow through the heating surfaces is virtually vertical, which also leads to lower return temperatures. Heat transfer medium is consequently stored in the energy store at far below the common 80° C and the size of the energy storage tank and consequently also the storage costs can be reduced substantially. Low return temperatures are favourable in the design of the energy storage tank and its loading.

According to a preferred embodiment, the inwardly-facing heating surface of the heater has a multitude of unevennesses, particularly a multitude of arched pockets arranged next to one another and above one another, which are connected to one another and through which the heating medium flows. The heating surface is preferably arranged in such a manner that the flow direction of the heating medium through these pockets is preferably formed in such a manner that an arched pocket is followed by a joint, and/or the flow direction of the liquid medium across the arched pockets is such that an arched pocket is followed by a joint. It is consequently possible to increase the heat transfer and consequently the K value on the heating agent side and the product side.

In order now to operate, e.g., a wort cooler with its design volume flows and design temperatures, located on the energy store is an agitator which mixes together the warmer heat transfer medium, e.g., from higher layers in an energy store, with the
relatively colder heat transfer medium of the lower layers of an energy store in the
demanded manner.

The device according to the invention comprises an open-loop control unit that, for a
specific process, open-loop controls the feed of a maximum quantity of liquid medium,
particularly a maximum quantity of mash up to a maximum level, whereby the heating
surface extends beyond this maximum level. A process in which the medium, i.e., the
mash, can run down along the heating surface to the surface level is consequently
ensured.

The thickness d2 of the heating surface advantageously amounts to 0.4 - 2 mm.

The device described above is particularly suited for heating mash. The device is,
however, likewise equally suited for heating other liquid media, particularly wort.

Due to the possibility of "irrigation" of media along the heating surface, one can also
degas / outgas other liquids, such as, e.g., sparge liquor for the lauter tun.

According to a preferred embodiment, the mash flows in a gap between the heating
surface and a confining element, in particular a confining plate, in the direction of the
surface level of the mash. The downwardly-flowing mash can consequently be kept in a
confined area. The mash can therefore be conveyed well along the heating surface and
kept in close contact with the heating surface. This can have an advantageous effect on
the heat transfer and also prevent a possible oxygen pick-up. Due to the small distance
to the actual heating surface or due to the narrow size (e.g., 3 to 20 mm) of the gap,
particularly of the annular gap, an oxygen-free area forms swiftly when the mash is
running down, whereby this oxygen-free area shields the mash from the rest of the gas
area. The confining element ends, e.g., just above or just below the mash level. The
confining element can thereby advantageously dip into the mash or into the mash level.

In this case, the downwardly-running mash does not at all come into contact with the
rest of the gas volume in the device.

According to this preferred embodiment of the device, the confining element, particularly
a confining plate, is arranged in such a manner that a gap forms between the heating
surface and the confining element, whereby the liquid medium flows through this gap in
the direction of the surface level. The gap is thereby preferably formed as an annular
gap. Annular gap is understood here to mean a continuous gap with a ring-shaped cross-section or also a divided gap or a gap divided into different segments.

The confining element extends preferably at least from a height range in which the liquid medium is applied onto the heating surface by the distribution device maximally into an area that lies above the container base. The mash can circulate in the device only if there is a distance between the confining element and the base. The confining element advantageously extends into an area of the centre inlet for the heating medium. Consequently, the previously explained counterflow heat exchanger principle can be supported.

If the gap, particularly the annular gap, is closed at the top, it is possible to prevent gas from being pulled back into the gap.

It is also possible to form the confining element itself as a heater, whereby the heating surface is then pointed towards the vessel frame and the mash can be heated additionally.

The present invention is explained in more detail in the following with reference to the following figures.

Fig. 1 shows schematically a sketch of a device according to a first embodiment of the present invention.

Fig. 2 shows schematically a sketch of a second embodiment according to the present invention.

Fig. 3 shows a perspective depiction of the heating surface of the device according to the invention.

Fig. 4 shows a partial longitudinal section through the heater according to the invention.

Fig. 5 shows a cross-section through the heater.

Fig. 6 shows a further embodiment according to the present invention.
Fig. 1 shows a device according to a first embodiment of the present invention. The device shown in Fig. 1 is suitable for mashing in the production of beer. The device 1 comprises a vessel 2, whose side wall 3 preferably is formed as a hollow cylinder. The vessel 2 has a hood or cover 4, in which is provided a vapour outlet pipe 5 for volatile components. Although not shown here, the vessel 2 can be connected to an energy recovery device. At the lower end, the vessel comprises a base 6, which preferably tapers conically downwards. Provided in the middle of the base is an outlet 10, here in the form of a discharge bowl, which is connected to an outlet line 31. Located in the outlet line 31 is a control valve 11. Furthermore provided in the outlet line is a pump 12 for pumping off the mash or a portion of the mash. For example, the mash can be drawn off after the mashing process via the line 23 with the valves 24 and 26 open. If the valve 24 is closed and the valves 25 and 26 are open, the mash can, as is also explained in more detail subsequently, be conveyed via the inlet line 22 to a distribution device 8, which can be located outside or inside of the container.

Additionally, located in the lower area of the device, here in the middle of the tun base, is an agitator. The agitator comprises a motor 21, a drive shaft, and agitator paddles 16. Agitator blades 32 can be provided in the discharge bowl.

In addition, the device also comprises an inlet 7 for mash. The introduction of the mash can take place from above via the lines 23 and 22 and the distribution device 8. It is, however, also possible to feed the mash to the device 1 via an inlet that is not shown and that is located in a lower area, for example, in the base or in the discharge bowl 10. In a particularly favourable design, metering devices, for example, for enzymes, calcium sulphate or calcium chloride, are provided in the inlet line 22, whereby this form of metering makes it possible to achieve uniform and homogenous dosing of the additions.

Provided on the side wall 3 of the vessel 2, at least across a portion of the height, is a heater 30, which preferably has an essentially hollow cylindrical form. In this embodiment, the heater is formed as a wall (frame heater) through which a heating medium flows. The heater can, however, also be arranged at a distance from or fitting against the side wall 3. The heater can also be formed by a plurality of segments arranged next to one another in the circumferential direction.

The heater 30 is preferably formed as shown in Fig. 3 to 5. Here the side wall is formed with double walls at least in sections and it has an outer wall 36 and an inner wall,
consequently the heating surface 13, whereby the thickness d1 of the outer wall is
greater than the thickness d2 of the inner wall. The two walls are connected to each
other at a multitude of joints 35, e.g., by means of welding, so that unevennesses arise
between the joints. The unevennesses have, for example, the form of a multitude of
preferably ballooned, arched pockets 34 that are arranged next to one another and
above one another, whereby said pockets are connected to one another and the heating
medium flows through said pockets. The heater 30 is advantageously aligned in such a
way that, particularly as follows from Fig. 3, in the flow direction of the heating medium
an arched pocket 34 is followed by a joint 35. The arrow in Fig. 3 shows the preferred
flow direction of the heating medium. Consequently there arises in the heating surface a
very high level of turbulence of the heating medium and a high heat transfer coefficient
on the heating agent side. The thickness d2 of the heating surface can, for example,
amount to 0.4 to 2 mm, and d1 can be in the range from 3 to 10 mm.

The flow through the pockets is consequently preferably in such a manner that each
pocket arch (area with the highest cross-section) is followed by a weld point.
Consequently there arises in the heating surface a very high level of turbulence of the
heat transfer medium and consequently a high heat transfer coefficient on the heating
agent side. This naturally means that unevennesses of the heating surface also result
on the product side between the joints, seen both in the cross-section and in the
longitudinal section, as follows particularly from Fig. 4 and 5. Due to the formation of
these unevennesses, the flow characteristics of the product liquid (e.g., mash) are
influenced positively and a more uniform flow of the product liquid along the frame
heating surface develops. Due to the formation of these unevennesses, it is also
possible to achieve an improved heat transfer to the mash, as a result of which the
temperature of the heating medium in turn can be reduced and naturally the return
temperature can also be further reduced.

As follows from Fig. 1, the heater comprises at least one inlet 14 for the heating
medium, whereby this inlet is arranged in the middle area of the heater 30 (seen in the
direction of the height). The inlet 14 can, for example, be arranged as a closed circuit
around the vessel 2, here in the form of a heating pipe, and it can have, distributed
around the circumference, a plurality of openings by way of which the heating medium is
conveyed into the heater 30, here the hollow spaces 37 (Fig. 3).
The heater 30 furthermore comprises at least one outlet 15a for the heating medium in the upper area of the heater 30. At least one outlet here means that provided in the heater, distributed around the circumference, is at least one opening by way of which the heating medium can be drawn off from the hollow spaces 37. The at least one outlet is connected to a line 41, here a half-pipe coil, that is arranged, at least in sections, around the circumference of the side wall 3 of the vessel 2. In addition to this, this closed circuit likewise has at least one outlet line 41 for the heating medium.

Likewise, provided in the lower area of the heater 30 is at least one outlet 15b, which is constructed as was described in connection with the at least one upper outlet 15a. This means that the heat transfer medium can run into the heater via the inlet 14 and, as depicted by the arrows, it can flow upwards and downwards to the corresponding outlets 15a, b.

The heater 30 extends into an area that lies above the surface level 20 of the mash. With the device according to the invention, it is also possible to heat very small mash portions without a base heater. It is also possible to provide a base heater that is constructed like the frame heater which was described in connection with Fig. 3 and 4. Such a base heater is not, however, mandatory.

Provided in an upper area of the heater 30 or above the heater 30 is a distribution device 8 that applies the mash onto the heating surface 13 above the surface level 20 in such a manner that the mash runs down along the heating surface 13 until it reaches the surface level 20 of the mash. The upper end of the heater and the distribution device 8 are thereby provided essentially in the upper quarter of the vessel 2. The distribution device can be arranged on the inside or outside of the vessel.

The arrangement of the heating surfaces and the flow of a heat transfer medium through them can naturally also take place in combination with a heating surface heated by vapour or high-pressure hot water, or one feeds vapour directly to a heat transfer medium "water" and discharges the corresponding "condensation quantity" again at the end.

One can achieve the same effect by reheating the heat transfer medium before it enters into the heating surfaces. This is necessary, e.g., when producing cooker mashess, in
which case the necessary driving force often cannot be achieved by means of recovered heat.

In the embodiment shown in Fig. 1, the distribution device is formed as a half-pipe that runs around the outer circumference of the vessel 2 (the same can, however, also be located on the interior of the vessel wall). Provided in the area of the half-pipe and distributed uniformly around the circumference of the side wall are breaches 9 or an annular gap. At the upper end of the opening 9, it is possible to provide a deflection device, here a deflection plate 19, that extends, at least in the area of the openings, diagonally downwards and that deflects the mash to the heating surface 13.

The mash 28 located in the vessel 2 can consequently be circulated to the distribution device 8 from the lower area via the pump 12 and the lines 31 and 22, whereby the mash is then fed back along the heating surface 13 in a thin flow via the distribution device 8.

The device furthermore can have a connection point for gas 27 such that the mashing device 1 can be supplied with gas. The device can also have a device, not shown, for generating a negative pressure in the device. The device is then preferably formed as a pressure vessel.

The device can furthermore also have an open-loop control unit 40 that open-loop controls the feed of a maximum quantity of mash up to a maximum filling level, whereby the heating surface 13 extends beyond this maximum filling level. The device can additionally have a filling level measurer, which is not shown, and also a temperature sensor. The open-loop control unit 40 can drive the control valves and the pump and also open-loop control the heating agent temperature, preferably via return admixing. The flow temperature and consequently accompanying it the return temperature should be as low as possible in order to achieve the advantages demonstrated above in the most optimal manner possible.

Fig. 2 shows a possible second embodiment of the present invention that corresponds to the embodiment shown in Fig. 1 with the exception that the distribution device 8 is not formed here as a half-pipe coil arranged on the outside of the vessel 2 and is instead formed as an annular pipe that is arranged in the interior of the vessel 2. The annular pipe thereby likewise has a plurality of breaches 9 distributed around the circumference
or one annular gap, whereby the breaches and / or the annular gap are arranged in such a manner that the mash is applied onto the heating surface 13 and runs down this until it reaches the surface level 20. Even although it is not shown, it is also possible to provide on the closed circuit a corresponding deflection device that deflects the mash in the direction of the heater 13. The pipe coils or closed circuits shown in Fig. 1 and Fig. 2 do not have to be formed continuously and can instead consist of a plurality of segments, each of which then has its own inlet line for mash.

With the possibility of having a product (in addition to mash, e.g., also CIP cleaning liquid) run down along the heating surface, this device can also be used as a heater or re-heater for various media, whereby the re-heating of, e.g., the brewhouse CIP cleaning liquid can eliminate the need for a separate heat exchanger and it is additionally possible to use the recovered energy from the process (which in turn saves primary energy).

The invention also allows the construction of slimmer, higher and more favourable mash containers (with filling levels of, e.g., 3 to 5 m and container heights of, e.g., 5 to 8 m with diameters of preferably 2 to 6 m). This in turn allows a very good A/V ratio, whereby the radiation losses are reduced.

In the following, the method according to the invention is explained in more detail with reference to Fig. 1.

In the method according to the invention, first mash 28 is introduced into the vessel 2 for the mashing. This can take place, for example, at least partially via the inlet 7 and via the distribution device 8. The valves 24 and 25 are thereby open and the valve 26 is closed. This means that at the time of the introduction of the mash into the vessel 2, the mash, as a thin film, as depicted by the arrow, is already running downwards on the heating surface 13 and is being heated. Due to the increase in the temperature of the mash, the gas bubbles in the thin film thereby enlarge and they can be expelled. In addition, the viscosity increases at the warmer boundary layer, as a result of which the enzymes can dissolve more easily and are more active. The vessel 2 can thereby be supplied with gas, e.g., nitrogen, via the inlet 27. The device is filled until a certain filling level has been reached. The corresponding switching of the valves, etc., is open-loop controlled by the open-loop control unit 40. The heater 30 here is heated with a heating medium, e.g., water, that preferably has a temperature in the range of the cooking
temperature, in an especially favourable design from 70 - 110° C, e.g., ideally 96° C. As described previously, the heating medium distributes from the inlet 14 upwards and downwards in the direction of the at least one outlet 15a, b. When leaving the heater, the heating medium then has, for example, a temperature of 80° C. The flow temperature of the heating medium preferably amounts to 10 to 30 K more than the respective product temperature of the mash, or of the medium to be heated. This means that as the product temperature rises, the heating medium temperature is adjusted in such a manner that the temperature difference between the product and the heating medium is in a range from 10 to 30 K. The arrangement of the heating surfaces and the flow of a heat transfer medium through them can naturally also take place in combination with a heating surface heated by vapour or high-pressure hot water, or one feeds vapour directly to a heat transfer medium "water" and discharges the corresponding "condensation quantity" again at the end. One can achieve the same effect by reheating the heat transfer medium before it enters into the heating surfaces. This is necessary, e.g., when producing cooker mashses, in which case the necessary driving force often cannot be achieved by means of recovered heat.

Due to the enlarged heating surface, which also extends above the surface level 20, no hot vapour customarily at a temperature of 140 to 150° C is required to heat the mash, so that gentler heating is possible at lower temperatures (<140° C), preferably in the range of or below the cooking temperature of the liquid heating medium. Furthermore, it is possible to use hot water from the heat recovery as the heating medium, i.e., heating medium that has been heated by means of waste heat, which, for example, arises during the wort cooling. Naturally the heating medium heated by the waste heat can also be raised to higher temperatures by means of a booster in order to compensate for fluctuations caused by the process or week.

Because no high-pressure hot water is used, the wall thickness d2 of the heating surface 13 can be designed to be weaker and thinner, which in turn provides an improved heat transfer. For example, the wall thickness d2 can lie in a range from 0.4 to 2 mm. This also has a positive effect on the welding work.

The mash 28 in the vessel 2 is pumped off during the mashing process, at least at times, and re-circulated back to the distribution device 8 via the line 31, pump 12 and line 22. The mash is then, via the distribution device 8 and distributed as uniformly as
possible around the circumference of the vessel 2, applied onto the heating surface 13. It then flows as a thin film / flow in the direction of the surface level 20. The thickness of the downwardly-running film of mash lies in a range of preferably 1 to 10 mm. The feed rate of the mash conveyed via the distribution device varies in the same manner, but additionally depends on the tun diameter.

The enlargement of the heating surface reduces the problem of the viscosity-caused reduction of the heat transfer in the event of higher concentrations (particularly in the event of hammer mill mashes with starch carriers such as sorghum or other unmalted raw materials) or during the gelatinisation phase. Under particularly favourable conditions, the very expensive use of technical enzymes can be reduced in this way.

As was also described in connection with the introduction of the mash, gas occlusions can be expelled due to the temperature increase while the mash is flowing down. Gas bubbles close to the surface can simply rip open. When the mash is running down, other volatile substances such as DMS can also be expelled from the mash. The mash here can be heated especially well in a counterflow, because, as follows from the arrows in Fig. 1, the mash flows downwards along the heating surface 13, while the heating medium, as likewise depicted by the arrows, flows upwards. This means that the mash can be heated additionally in an area above the introduced mash 28. The mash is agitated by means of the agitator 16 in the lower area of the device. Due to the additional intermixing by the mash that is circulated, the agitator can be given much smaller dimensions and the shearing forces can be reduced. Due to the addition of mash from the distribution device 8, the intermixing of the mash in the uppermost liquid layers improves relatively independently of the mash filling level. Due to the lift caused by the agitator paddles 16, as well as due to the thermal lift, the mash strives upwards at the side wall 3, as shown by the arrow. Mash particles with a low density strive more strongly upwards and float there very easily. Most of the mash particles migrate in the upper liquid area in the direction of the centre, and then from there downwards again, so that the circuit indicated with 18 results. A somewhat "colder" mash is often located in the tun centre 17. The homogeneity of the mash temperature is improved by drawing off a portion of the mash from the middle area from below, here via the discharge bowl 10, and finally returning it to the tempered heating surface 13. This improves the enzyme activity substantially. For example, the homogeneity is improved especially in the case of very concentrated mashes (high-gravity method). Even if not shown in Figure 1 and 2,
it is also possible, in order to improve the homogeneity, to introduce mash, additionally or during the mashing in, in the tun centre 17 via the discharge bowl 10 with a line that is not shown.

Due to the high volume flow in the discharge bowl 10, it is possible to dispense with agitator blades 32 in the discharge bowl. In the lower area, the mash can likewise be heated by the heater 30 in a counterflow, because here the mash rises upwards at the side walls, as is depicted by the arrows, while the heating medium flows downwards. The quantity of mash that is fed in circulation from the lower area of the vessel 2 to the distribution device 8 via the line 22 can be adjusted by adjusting the corresponding control valves as well as the pumping capacity 12.

At the end of the mashing process, the mash can then be pumped off via the outlet 10 and the opened valves 11, 26, and 24 by means of the pump 12. Here the mash is both pumped off and pumped in circulation by means of the mash pump 12. It is also possible to provide two different pumps, however.

Due to the low heating medium temperatures, the previously described mashing method can also be carried out without strict compliance with resting at a constant temperature. The heating rate during this resting is then, e.g., 0.1 K/min.

The liquid medium, e.g., mash, is hereby heated at a predetermined heating rate, e.g., 0.8 K/min., until just below the classic resting temperature. During the, e.g., 20-minute rest, the "heating" continues at a distinctly slower heating rate, e.g., at 0.1 K/min. so that the temperature of the liquid medium at the end of the "rest" lies somewhat higher than the classic resting temperature, but still in the optimum of the respective enzyme range.

The device shown in Fig. 1 and 2 has been described in connection with a mashing process. It is also possible, however, to use this device as a device for heating other media, particularly wort. In such a case, e.g., wort would be conveyed via the distribution device 8 and onto the surface level of the wort 20 instead of mash 28.

Fig. 6 shows a possible variant of the embodiments depicted in Fig. 1 to 5. The device 1 according to the invention is thereby depicted only in a roughly schematic form. The embodiment corresponds to the previous embodiments except that a confining element 50, here in the form of a confining plate, is additionally provided. In this special
embodiment, the confining element 50 is formed in such a manner that a gap 51 results between the heating surface 13 and the confining element. The confining element 50 is advantageously formed and arranged in such a manner that an annular gap results. The annular gap can be continuous or it can consist of a plurality of segments arranged in a ring shape. The gap width s is from 3 to 20 mm. In a lower area (in the lower 5 to 30%) of the confining element 50, the dimension of the gap width can be reduced to a smaller size (meaning shortly before the downwardly-running mash runs into the remaining mash, because here there is a slight risk of oxygen pick-up).

The confining element 50 extends at least from an area that lies on a level at which the mash is applied onto the heating surface 13 by the distribution device. In this way, the mash is already conveyed downwards by the confining element 50 directly when being brought onto the heating surface 13. The confining element does not extend completely to the vessel base 6 and instead ends above this, in order to guarantee circulation. The confining element preferably ends in the area of the middle heating agent feed 14, in order in this way to support the counterflow heat exchanger principle that was described in connection with Fig. 1 and 2. The confining element 50 can consequently end just above or just below the mash level. The length of the confining element 50 is advantageously designed such that it dips into the surface level 20. Advantages of the confining element also result, however, if the confining element ends up to 20 cm above the surface level (with overall heights of preferably approximately 2.5 to 8 m in the device).

The gap or annular gap 51 is advantageously closed at the top, so that no gas can be pulled back into the annular gap from the vessel 2 when the mash runs down through the gap 51 towards the surface level. In Fig. 6, the confining element 50 is connected to the cover 4. The confining element 50 can also be formed as a heater and have a heating surface facing outwards, i.e., towards the outer wall of the vessel 2. The mash can be heated additionally in this way. The heating medium then advantageously flows through the confining element from the bottom up in order to heat the mash in a counterflow. The heating surface can preferably have unevennesses. Particularly if the confining element 50 is formed as a heating surface, it can also, according to a further embodiment, be advantageous for improved heating if it projects farther into the mash, however to a maximum of roughly 50 cm above the base.
With the confining element according to the invention, the downwardly-flowing mash can be conveyed along the heating surface 13 and held in a confined area. Consequently it is possible on the one hand to minimize further or completely prevent any minor oxygenation and on the other hand also to improve the heat transfer. Due to the small distance from the confining element to the actual heating surface 13, a very narrow annular gap forms, so that an oxygen-free area forms swiftly and the mash is more or less shielded from the gas area. The confining element also allows the mash to be introduced essentially tangentially into the vessel 2. The distribution device is then formed as at least one tangential inlet in such a manner that the mash flows essentially tangentially to the inner side of the vessel wall or the confining element so that an upward flow that rotates around the middle axis M results.
PATENTKRAV

1. Fremgangsmåde til mæskning ved fremstilling af øl, omfattende følgende trin:

   at indføre mask (28) i en mæskeindretning (1),
   at pumpe en del af denne mask bort og at tilføre denne mask til en fordelerindretning (8), der påfører masken over maskens spejloverflade (20) på en varmeflade (13) ved sidevæggen (3) af en beholder (2) i mæskeindretningen således, at masken via varmefladen (3) løber ned indtil maskens spejloverflade (20).

2. Fremgangsmåde ifølge krav 1, kendetegnet ved, at varmefladen opvarmes med et opvarmningsmedium, der under de forskellige procesafsnit har en fremløbstemperatur, der fortrinsvis er 10-30 K højere end den respektive produkttemperatur af masken, der skal opvarmes, og/eller fremløbstemperaturen ved et flydende opvarmningsmedium ligger i området af opvarmningsmediets kogetemperatur eller er mindre end kogetemperaturen.

3. Fremgangsmåde ifølge krav 1 eller 2, kendetegnet ved, at masken påføres på varmefladen (13) i et øvre område, især i den øvre fjerdedel af mæskeindretningen (1).

4. Fremgangsmåde ifølge mindst et af kravene 1 til 3, kendetegnet ved, at masken lagres i mæskeindretningen (1) fortrinsvis via fordelerindretningen.

5. Fremgangsmåde ifølge mindst et af kravene 1 til 4, kendetegnet ved, at mæskeindretningen (1) påvirkes med gas, og/eller der frembringes et undertryk i mæskeindretningen.

6. Fremgangsmåde ifølge mindst et af kravene 1 til 5, kendetegnet ved, at masken pumpes bort fra det nedre område af mæskeindretningen (1), især fra det midterste bundområde, ved bortpumpning af en del af masken.

7. Fremgangsmåde ifølge mindst et af kravene 1 til 6, kendetegnet ved, at masken omrøres i det nedre område af mæskeindretningen (1).
8. Indretning til udvæelse af fremgangsmåden ifølge mindst krav 1, omfattende en beholder (2), der udviser et tilløb (7) og et udløb (10), et varmeaggregat (30) ved sidevæggen (3) af beholderen (2) til opvarmning af masken (28) og omfattende en pumpeindretning (12) til at pumpe masken (28) ind i en fordelerindretning (8), hvor fordelerindretningen (8) er udformet således, at masken påføres på en varmeflade (13) af varmeaggregatet, der strækker sig over spejloverfladen (20) og derfra kan løbe ned indtil spejloverfladen, hvor indretningen omfatter en styreindretning (40), der styrer tilførslen af en maksimal mængde mask op til en maksimal fyldningsgrad, idet varmefladen (13) strækker sig ud over denne maksimale fyldningsgrad.

9. Indretning ifølge krav 8, kendtegnet ved, at fordelerindretningen (8) er anbragt i den øvre fjerdedel af beholderen (2) og fortrinsvis er udformet som ringrør eller som halv rørs lange med åbninger (9) eller en ringspalte (9).

10. Indretning ifølge mindst et af kravene 8 eller 9, kendtegnet ved, at varmeaggregatet (30) udviser mindst et udløb (15a) til opvarningsmediet i det øvre område af varmeaggregatet, mindst et udløb (15b) i det nedre område af varmeaggregatet og mindst et tilløb (14) til opvarningsmediet, der er anbragt i det midterste område af varmeaggregatet (30), idet opvarningsmediet fortrinsvis strømmer gennem varmefladen vertikalt, hvorved der opstår en modstrømsvarmeoverføring.

11. Indretning ifølge mindst et af kravene 8 til 10, kendtegnet ved, at den indadsvendte varmeflade (13) af varmeaggregatet (30) udviser et antal ujævnheder, især et antal buede lommer (34), der er anbragt ved siden af hinanden og over hinanden, og som står i forbindelse med hinanden, og gennem hvilke opvarningsmediet strømmer.

12. Indretning ifølge mindst et af kravene 8 til 11, kendtegnet ved, at opvarningsmediets strømningsretning gennem disse lommer fortrinsvis er dannet således, at en buet lomme (34) følges af et forbindelsessted (35), og/eller det flydende mediums strømningsretning via de buede lommer er således, at en buet lomme (34) følges af et forbindelsessted (35).
13. Indretning ifølge krav 11, **kendetegnet ved**, at tykkelsen d2 af varmefladen udgør 0,4-2 mm.

14. Fremgangsmåde ifølge mindst 1ets af kravene 1 til 7, **kendetegnet ved**, at masken (28) i en spalte (51), mellem varmefladen (13) og et afgrænsningselement (50), især en afgrænsningsplade, løber ned i retning af maskens spejloverflade (20).

15. Indretning ifølge mindst et af kravene 8 til 13, **kendetegnet ved**, at indretningen endvidere udviser et afgrænsningselement, især en ringformet afgrænsningsplade, der er anbragt således, at der mellem varmeflade (13) og afgrænsningselement dannes en spalte (51), gennem hvilken det flydende medium strømmer i retning af spejloverfladen (20).

16. Indretning ifølge mindst et af kravene 8 til 13 eller 15, **kendetegnet ved**, at afgrænsningselementet strækker sig mindst fra et højdeområde, hvor det flydende medium af fordelerindretningen (8) påføres på varmefladen (13), til maksimalt ind i et område, der ligger over karbunden (6).

17. Indretning ifølge mindst krav 15 eller 16, **kendetegnet ved**, at spalten (51) er en ringspalte og især er lukket opadtil.

18. Indretning ifølge mindst et af kravene 8 til 13 og 15 til 17, **kendetegnet ved**, at afgrænsningselementet (50) er udformet som varmeaggregat.