The invention relates to an apparatus for producing flake ice from a liquid, comprising a tub receiving the liquid, a rotatably supported roller which partly dips into the liquid received in the tub, a refrigerating device for cooling the surface of the roller and a scraper for removing ice formed at the surface of the roller from the liquid.
DEVICE FOR THE PRODUCTION OF FLAKE ICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims the benefit of priority to German Patent Application Serial No. 10201017038.3, filed Apr. 14, 2011, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to an apparatus for producing flake ice from a liquid, and more particularly to a tub receiving the liquid, a rotatably supported roller which partly dips into the liquid received in the tub, a refrigerating device for cooling the surface of the roller and a scraper for removing ice formed at the surface of the roller from the liquid.

BACKGROUND

Flake ice is used in the food industry for refrigerating fresh goods, e.g. fresh fish or seafood, during transport or in the display counter of a food store, or also as an ice admixture in the manufacture of batter. Stringent hygienic regulations must be observed due to the direct contact of the flake ice with the foods.

In one apparatus, the roller is a component of the refrigeration machine. This roller is specifically an evaporator roller which is flowed through by refrigerant and in which liquid refrigerant is evaporated under heat exchange with the liquid to be frozen. The evaporator roller thus forms the evaporator of the refrigeration circuit of the refrigeration machine. The apparatus has proved to be problematic to the extent that it must in every case be avoided that refrigerant, which is usually not food compatible, comes into contact with the liquid to be frozen. High demands must therefore be made on the tightness of the refrigerant circuit in the region of the roller and its bearing.

It is an underlying feature of the invention to provide an apparatus for producing flake ice which can be manufactured and operated with a smaller economic effort and in which the risk of a contamination of the flake ice by refrigerant is minimized.

BRIEF DESCRIPTION OF THE INVENTION

The above-referenced feature is provided by an apparatus for producing flake ice from a liquid, the apparatus including a tub receiving the liquid, a rotatably supported roller which partly dips into the liquid received in the tub, a refrigerating device for cooling the surface of the roller and a scraper for removing ice formed at the surface of the roller from the liquid. The roller is part of a closed refrigerant agent circuit which is in a heat-exchanging relationship with a closed refrigerant circuit of a refrigeration machine.

An embodiment of the invention is to provide the roller not as a component of the refrigeration machine, i.e. as an evaporator, but rather to couple the roller indirectly, namely via a separate refrigerant agent circuit, to the refrigeration machine so that the roller does not come into contact with refrigerant. Instead, the roller is only flowed through by a refrigerant agent which cannot mix with the refrigerant, but only exchanges heat with it.

The use of refrigerant can be limited to a central refrigeration circuit of the refrigeration machine by the separation of refrigerant circuit and refrigerant agent circuit. This allows a reduction of the refrigerant filling capacity, the realization of a higher icing performance with lower legal requirements on design and operation, the spatial separation between the refrigeration producer, i.e. the refrigeration machine, and the consumer, i.e. therefore the roller, the usage option of all existing refrigerants and the connection possibility of the apparatus to already existing refrigeration circuits.

The refrigerant agent of the refrigerant agent circuit which flows through the roller and the refrigerant of the refrigeration machine may be different substances. This makes it possible to use a refrigerant which ensures an ideal refrigerating operation of the refrigeration machine and to select a refrigerant agent, for example a brine, which is food-safe for the refrigerant agent circuit. The refrigerant agent furthermore also takes over a storage function and can thus compensate load fluctuations.

The additional apparatus effort which arises due to the formation of two separate circuits, namely the refrigerant circuit, on the one hand, and the refrigerant agent circuit, on the other hand, is compensated by a plurality of advantages. The roller thus does not need to withstand any high internal pressures, whereby simpler roller designs can be considered. The fact that the refrigerant agent can generally flow through the roller at environmental pressure also means that seals for sealing the refrigerant agent circuit in the region of the roller can be designed as simpler and thus less expensive, with smaller demands being able to be made on the sealing effects of these seals when the apparatus is operated with a food-compatible refrigerant agent.

Advantages in the manufacture of the apparatus in accordance with embodiments of the invention, however, do not only result through a simpler design of the roller and of the seals, but also through the use of less expensive materials for the refrigerant agent lines since plastic can, for example, be used instead of copper for this purpose. The control and the assembly of the apparatus are furthermore simplified.

As a result, the apparatus therefore not only ensures increased food-safety, but it can also be manufactured and operated overall with a smaller economic effort.

An embodiment of the roller provides, for example, that the roller includes a core and a jacket, with the jacket surrounding the core and a flow passage for the refrigerant agent being formed between the jacket and the core. In the simplest case, the flow passage can have the form of an annular clearance between the jacket and the core. The refrigerant agent flowing through the annular clearance is in contact with the full area of the inner side of the jacket, whereby the jacket is cooled and heat is removed from the liquid to be frozen. To increase the refrigerating efficiency, the contact surface between the refrigerant agent and the roller in the flow passage, e.g. an open-pore metal foam which can be penetrated by the refrigerant agent.

In accordance with a further embodiment, the roller is suspended at two holding arms. The roller can, for example, be rotatably supported at the holding arms by stub shafts formed at the end faces of the roller. The suspension of the roller at the holding arms makes possible an arrangement of the tub independent of the roller, whereby the assembly and dismantling of the tub, e.g. for cleaning purposes or maintenance purposes, is substantially simplified. The scraper or a
liquid inflow for introducing the liquid to be frozen into the tub is advantageously also not installed at the tub or at least releasably connected to the tub to facilitate the installation and removal of the tub.

[0015] The tub can include two side parts and a base part which releasably or non-releasably connects the two side parts to one another. In the installed state of the tub, the side parts can lie in two planes perpendicular to the axis of rotation of the roller. The base part in contrast may extend parallel or at least approximately parallel to the axis of rotation of the roller.

[0016] The tub can be formed from a plastic material, in one piece for example. Alternatively, the tub can, however, also comprise a metal material, such as stainless steel or steel, or a composite material.

[0017] If the side parts and the base part of the tub are formed as separate components, it is advantageous if sealing elements are located at the side parts which extend at least along a part periphery of the side parts and provide a sealing engagement between the base part and the side parts. The side parts can, for example, be provided with a groove which extends at least over a part periphery to receive the sealing elements, with the sealing elements typically adopting a clamping seat in the groove so that they remain therein with a removed base part.

[0018] In accordance with a further construction design, the lateral end regions of the base part contact the end faces of the side parts. The base part can be fixable to the side parts by a clamping device for a simplified assembly of the tub. The side parts for this purpose may have a substantially round or oval outer contour while the base part has a substantially rectangular base shape in the planar projection.

[0019] To fix the tub relative to the roller in the installed state, the side parts of the tub can be fastened to the holding arms from the outside. Alternatively or additionally, it is also possible to mount the tub on a suitable rack without a supporting connection to the holding arms or to the roller.

[0020] The scraper can also be installed independently of the tub, for example at a crossbeam, so that it remains at the crossbeam on the removal of the tub and is freely accessible from the outside to be cleaned and/or disinfected or also dismantled.

[0021] In accordance with a further embodiment, a sloped plane is provided via which the ice removed from the roller by the scraper is led off. In this respect, the sloped plane can cover fastening elements for the scraper to prevent the fastening elements from coming into contact with the flake ice.

[0022] Furthermore, at least one liquid inflow can be provided to introduce the liquid to be frozen into the tub, e.g. from above. The liquid inflow may have at least one outlet opening for the liquid which is located beneath the scraper. Alternatively or additionally, the liquid inflow can have at least one outlet opening which is located between one of the two end faces of the roller and a side part of the tub.

[0023] In accordance with a further embodiment, a liquid application device is provided which applies the liquid directly to the jacket of the roller. The liquid application device can be provided additionally or alternatively to a liquid inflow and can, for example, be arranged above the roller axis so that the liquid application takes place onto the roller from above or obliquely from above. The liquid application device may extend over substantially the total length of the roller. The liquid application device is also advantageously installed independently of the tub. A pump can be provided to suck liquid from the tub and to pump it via the liquid application device onto the roller.

[0024] The tub can be upwardly coverable at least partly by a cover at which the liquid inflow can be releasably or fixedly arranged.

[0025] In accordance with a further embodiment, a cleaning device is provided for cleaning the tub and the roller which may have a plurality of nozzles for spraying the roller and the tub with a cleaning agent, e.g. with a cleaning liquid. A circulating device can additionally be provided to generate a flow in the cleaning liquid in the tub by which the cleaning result is improved. The circulating device can include a circulating pump, e.g. an immersion pump, which sucks the cleaning liquid from the tub and convey it back into the tub.

[0026] Alternatively or additionally, the circulating device can include a stirring unit which effects a flow of the cleaning liquid in the tub. The stirring unit can have a separately driven shaft with at least one axially or radially conveying stirrer and/or can be formed by at least one stirrer formed at the roller, in particular at an end face of the roller.

[0027] The inflow of cleaning liquid into the tub takes place in accordance with a simple construction design via the inflow through which the liquid to be frozen is also introduced into the tub. The cleaning liquid can accordingly be let out of the tub through an outflow which is also provided for letting out the liquid to be frozen.

[0028] A plant control is advantageously provided which detects the operating times and/or standstill times of the apparatus in order to draw a conclusion on the hygienic condition from this and, on the reaching of a critical hygienic condition, to initiate a cleaning process which can either be started automatically or can be triggered manually by a user after a corresponding signaling.

[0029] The roller may have an inlet passage for the refrigerant agent at its one axial end and an outlet passage for the refrigerant agent at its other axial end. This allows a through-flow of the roller by the refrigerant agent over substantially the total extent of the roller, viewed in the axial direction, which is here called the length of the roller.

[0030] In accordance with an embodiment, the inlet passage and the outlet passage each include a blind bore which extends axially into one of the stub shafts of the roller. In addition, the inlet passage and the outlet passage can each include at least one radial bore which extends radially in a core of the roller and connects an axial blind bore to an annular clearance between the core and the jacket of the roller. A feed passage connected to the inlet passage is provided in the holding arm and a discharge passage connected to the outlet passage is provided in the holding arm for the feed and discharge of refrigerant agent into and out of the roller.

[0031] In accordance with a further embodiment, a rotary drive for the roller is arranged offset from the axis of rotation of the roller. The rotary drive can include a drive gear, for example, which is in engagement with a sprocket attached to the roller at the end face. The drive of the roller in other words takes place in a decentralized manner whereby the installation of the tub beneath the roller can be realized free of seals.

[0032] The invention will be described in the following by way of example with reference to the accompanying drawings and the enclosed description.
BRIEF DESCRIPTION OF THE DRAWINGS

[0033] FIG. 1 a schematic representation of an apparatus for producing flake ice;
[0034] FIG. 2 a schematic diagram of the mode of operation of an apparatus in accordance with the invention for producing flake ice;
[0035] FIG. 3 a longitudinal sectional view of an apparatus in accordance with the invention for producing flake ice; and
[0036] FIG. 4 (a) a front side view of the apparatus of FIG. 3 and (b) a cross-sectional view of the apparatus.

DETAILED DESCRIPTION

[0037] The general structure of an apparatus for producing flake ice is shown in FIG. 1. The apparatus includes a tub 10 in which a liquid 12, typically water, to be processed to ice is located. A closable outflow 14 is formed in the base of the tub 10 through which the liquid 12 can be let out of the tub 10 for cleaning purposes.

[0038] A substantially cylindrical roller 16, also called an ice drum, is horizontally arranged above the tub 10 such that it partly dips into the liquid 12. The jacket 18 of the roller 16 is cooled down to the freezing temperature of the liquid 12 or to an even lower temperature by a refrigerating device 20 (FIG. 2) explained in more detail in the following. The low temperature of the jacket 18 has the result that liquid 12 freezes solid at the jacket 18 and forms an ice layer 22 on it. The ice layer 22 is scraped off the roller 16 by a scraper 26 while rotating the roller 16 about its cylinder axis, in the direction of rotation indicated by the arrow 24 in FIG. 1, and is supplied for further use as flake ice 28.

[0039] As FIG. 2 shows, the refrigerating device 20 provided for cooling the jacket 18 includes two refrigeration circuits separate from one another and closed within themselves, namely on the one hand a refrigerant circuit 30 for providing the desired low temperature and on the other hand a refrigerant agent circuit 32 through which the cold generated by the refrigerant circuit 30 is transported to the roller 16.

[0040] The refrigerant circuit 30 includes a restrictor member 34, an evaporator formed as a heat exchanger 36, e.g. a plate heat exchanger, a compressor 38 and a condenser 40 and thus forms a refrigeration machine in which the circulating refrigerant changes to and fro between the gaseous state and the liquid state.

[0041] The refrigerant agent circuit 32 is coupled to the refrigerant circuit 30 via the heat exchanger 36 so that a refrigerant agent, e.g. a brine, circulating in the refrigerant agent circuit 32 exchanges heat with the refrigerant of the refrigerant circuit 30 and is hereby cooled down to the desired temperature. The cooled refrigerant agent is pumped through the roller 16 by a pump 42 to cool the jacket 18 to the desired low temperature and to freeze the liquid 12 while removing the heat at the jacket 18. The heat taken up by the refrigerant agent during this process is subsequently output in the heat exchanger 36 to the refrigerant of the refrigerant circuit 30, whereby the refrigerant is evaporated. The refrigerant agent in contrast is always present in the liquid state.

[0042] As FIGS. 3 and 4 show, the roller 16 is rotatably supported at two holding arms 44 which are in turn suspended at a cross-member 46.

[0043] The roller 16 has two stub shafts 48, which are received in corresponding bearings 50 of the holding arms 44 for the rotatable support of the roller 16 at the holding arms 44. The stub shafts 48 project axially from a substantially cylindrical core 52 of the roller 16 which defines a first diameter d.

[0044] In the transition region between the core 52 and one of the stub shafts 48, the right hand stub shaft in FIG. 3, a radially extending peripheral projection 54 is formed which defines a second diameter D which is larger than the first diameter d.

[0045] A circular end disk 56 is placed onto the oppositely disposed stub shaft 48, the left hand stub shaft in FIG. 3, such that it contacts the core 52 at the end face. A shoulder is formed at the peripheral surface of the end disk 56 such that the end disk 56 has a first peripheral surface section 58 in which the end disk 56 has the second diameter D and in addition a second peripheral surface section 60 in which the end disk 56 has a diameter which is larger than the second diameter D.

[0046] The second peripheral surface section 60 is provided with a sprocket 62 which is in engagement with a drive gear 64. The drive gear 64 is drivable by a drive motor not shown, to set the roller 16 into rotation. The drive, which is arranged offset from the axis of rotation of the roller 16, i.e. that is in a decentralized manner, in this respect allows a seal-free positioning of the tub 10, whereby a dismantling of the tub 10 for cleaning purposes is considerably facilitated.

[0047] As FIG. 3 shows, the first peripheral surface section 58 of the end disk 56 is adjacent to the radially extending peripheral projection 54. The jacket 18 which surrounds the core 52 and which is releasably fastened, e.g. screwed, to the end disk 56 and to the projection 54 lies on the first peripheral surface section 58 and on the projection 54.

[0048] Due to the difference between the first diameter d and the second diameter D, an annular clearance 68 is formed between the core 52 and the jacket 18 and is filled with an open-pore metal foam 70 which can be penetrated by the refrigerant agent.

[0049] An axially extending blind bore 72 is formed in each stub shaft 48 and is connected to the annular clearance 68 in the region of its inner end via two radial bores 74 extending radially in opposite directions. The blind bores 72 are furthermore connected to refrigerant agent passages 76 which are provided in the holding arms 44. The refrigerant agent passages 76, blind bores 72, radial bores 74 and the annular clearance 68 allow a throughflow of the roller 16 by the refrigerant medium of the refrigerant agent circulating in the refrigerant agent circuit 32.

[0050] In the embodiment shown, the refrigerant agent is supplied through the refrigerant agent passage 76 of the left hand holding arm 44 in FIG. 4 to the roller 16 so that this refrigerant agent passage 76 can also be called a feed passage 78. The refrigerant agent supplied through the feed passage 78 penetrates through the left hand blind bore 72 in FIG. 3 into the roller 16 and is distributed through the left hand radial bores 74 in FIG. 3 into the annular clearance 68, i.e. the left hand bores 72, 74 in FIG. 3 form an inlet passage 80.

[0051] The refrigerant agent which has entered into the annular clearance 68 flows through the metal foam 70 and exits the roller 16 again through the right hand bores 74 in FIG. 3 and through the right hand blind bore 72, which here act as an outlet passage 82, to be led off through the refrigerant agent passage 76 of the right hand holding arm 44 in FIG. 3 so that this refrigerant agent passage 76 is also called a discharge passage 84.
Whereas the roller 16 shown in FIG. 3 is therefore ultimately flowed through from left to right, it is self-explanatory that the flow direction can also be reversed as required.

Due to the throughflow of the roller 16 by the refrigerant agent, the jacket 18 is cooled down to such a low temperature that the liquid located in the tub 10 freezes at the outer surface of the jacket 18 and forms an ice layer 22 which, as already mentioned above, is scraped off from the jacket 18 with the aid of the scraper 26 to form flake ice 28 when the roller 16 is set into rotation by the drive gear 64.

While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

An apparatus for producing flake ice from a liquid, comprising a tub receiving the liquid, a rotatably supported roller which partly dips into the liquid received in the tub, a refrigerating device for cooling the surface of the roller and a scraper for removing ice formed at the surface of the roller from the liquid;

wherein the roller is part of a closed refrigerant agent circuit which is in a heat-exchanging relationship with a closed refrigerant circuit of a refrigeration machine.

17. An apparatus in accordance with claim 16, wherein the roller includes a core and a jacket, with the jacket surrounding the core and a flow passage for the refrigerant agent being formed between the jacket and the core.

18. An apparatus in accordance with claim 17, wherein the flow passage is formed by an annular clearance between the jacket and the core extending over at least approximately the total length of the roller.

19. An apparatus in accordance with claim 17, wherein a means for increasing the contact surface between the refrigerant agent and the roller is provided in the flow passage.

20. An apparatus in accordance with claim 17, wherein a means for increasing the contact surface between the refrigerant agent and the roller at least approximately completely fills an annular clearance between the jacket and the core.

21. An apparatus in accordance with claim 20, wherein said means is a metal foam which can be penetrated by the refrigerant agent.

22. An apparatus in accordance with claim 16, wherein the refrigerant agent of the refrigerant agent circuit is different from the refrigerant of the refrigerant circuit.

23. An apparatus in accordance with claim 22, wherein the refrigerant agent of the refrigerant agent circuit is food-safe.

24. An apparatus in accordance with claim 16, wherein the roller is suspended at two holding arms.

25. An apparatus in accordance with claim 24, wherein the roller is rotatably supported at the holding arms by means of stub shafts formed at the end faces of the roller.

26. An apparatus in accordance with claim 24, wherein the roller has an inlet passage for the refrigerant agent at its one axial end and an outlet passage for the refrigerant agent at its other axial end, and wherein a feed passage connected to the inlet passage is provided in the one holding arm and a discharge passage connected to the outlet passage is provided in the other holding arm.

27. An apparatus in accordance with claim 16, wherein the roller has an inlet passage for the refrigerant agent at its one axial end and an outlet passage for the refrigerant agent at its other axial end.

28. An apparatus in accordance with claim 27, wherein the inlet passage and the outlet passage each include a blind bore which extends axially into one of the stub shafts of the roller.

29. An apparatus in accordance with claim 27, wherein the inlet passage and the outlet passage each include at least one radial bore which extends radially in a core of the roller and connects an axial blind bore to an annular clearance between the core and the jacket of the roller.

30. An apparatus in accordance with claim 16, wherein a rotary drive for the roller is arranged offset from the axis of rotation of the roller.

31. An apparatus for producing flake ice from a liquid, comprising a tub receiving the liquid, a rotatably supported roller which partly dips into the liquid received in the tub, a refrigerating device for cooling the surface of the roller and a scraper for removing ice formed at the surface of the roller from the liquid;

wherein the roller includes a core and a jacket, with the jacket surrounding the core and a flow passage for the refrigerant agent being formed between the jacket and the core.

32. An apparatus in accordance with claim 31, wherein the roller is part of a closed refrigerant agent circuit which is in a heat-exchanging relationship with a closed refrigerant circuit of a refrigeration machine.

33. An apparatus in accordance with claim 31, wherein the flow passage is formed by an annular clearance between the jacket and the core extending over at least approximately the total length of the roller.

34. An apparatus in accordance with claim 31, wherein a means for increasing the contact surface between the refrigerant agent and the roller is provided in the flow passage.

35. An apparatus in accordance with claim 31, wherein a means for increasing the contact surface between the refrigerant agent and the roller at least approximately completely fills an annular clearance between the jacket and the core.

36. An apparatus in accordance with claim 35, wherein said means is a metal foam which can be penetrated by the refrigerant agent.

37. An apparatus in accordance with claim 31, wherein the refrigerant agent of the refrigerant agent circuit is different from the refrigerant of the refrigerant circuit.

38. An apparatus in accordance with claim 37, wherein the refrigerant agent of the refrigerant agent circuit is food-safe.

39. An apparatus in accordance with claim 31, wherein the roller is suspended at two holding arms.

40. An apparatus in accordance with claim 39, wherein the roller is rotatably supported at the holding arms by means of stub shafts formed at the end faces of the roller.

41. An apparatus in accordance with claim 31, wherein the roller has an inlet passage for the refrigerant agent at its one axial end and an outlet passage for the refrigerant agent at its other axial end.

42. An apparatus in accordance with claim 41, wherein the inlet passage and the outlet passage each include a blind bore which extends axially into one of the stub shafts of the roller.
43. An apparatus in accordance with claim 41, wherein the inlet passage and the outlet passage each include at least one radial bore which extends radially in a core of the roller and connects an axial blind bore to an annular clearance between the core and the jacket of the roller.

44. An apparatus in accordance with claim 39, wherein the roller has an inlet passage for the refrigerant agent at its one axial end and an outlet passage for the refrigerant agent at its other axial end, and wherein a feed passage connected to the inlet passage is provided in the one holding arm and a discharge passage connected to the outlet passage is provided in the other holding arm.

45. An apparatus in accordance with claim 31, wherein a rotary drive for the roller is arranged offset from the axis of rotation of the roller.

46. An apparatus in accordance with claim 39, wherein the rotary drive includes a drive gear which is in engagement with a sprocket attached to the roller at the end face.

47. An apparatus in accordance with claim 45, wherein the rotary drive includes a drive gear which is in engagement with a sprocket attached to the roller at the end face.