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SLUSH ICE MAKING MACHINE

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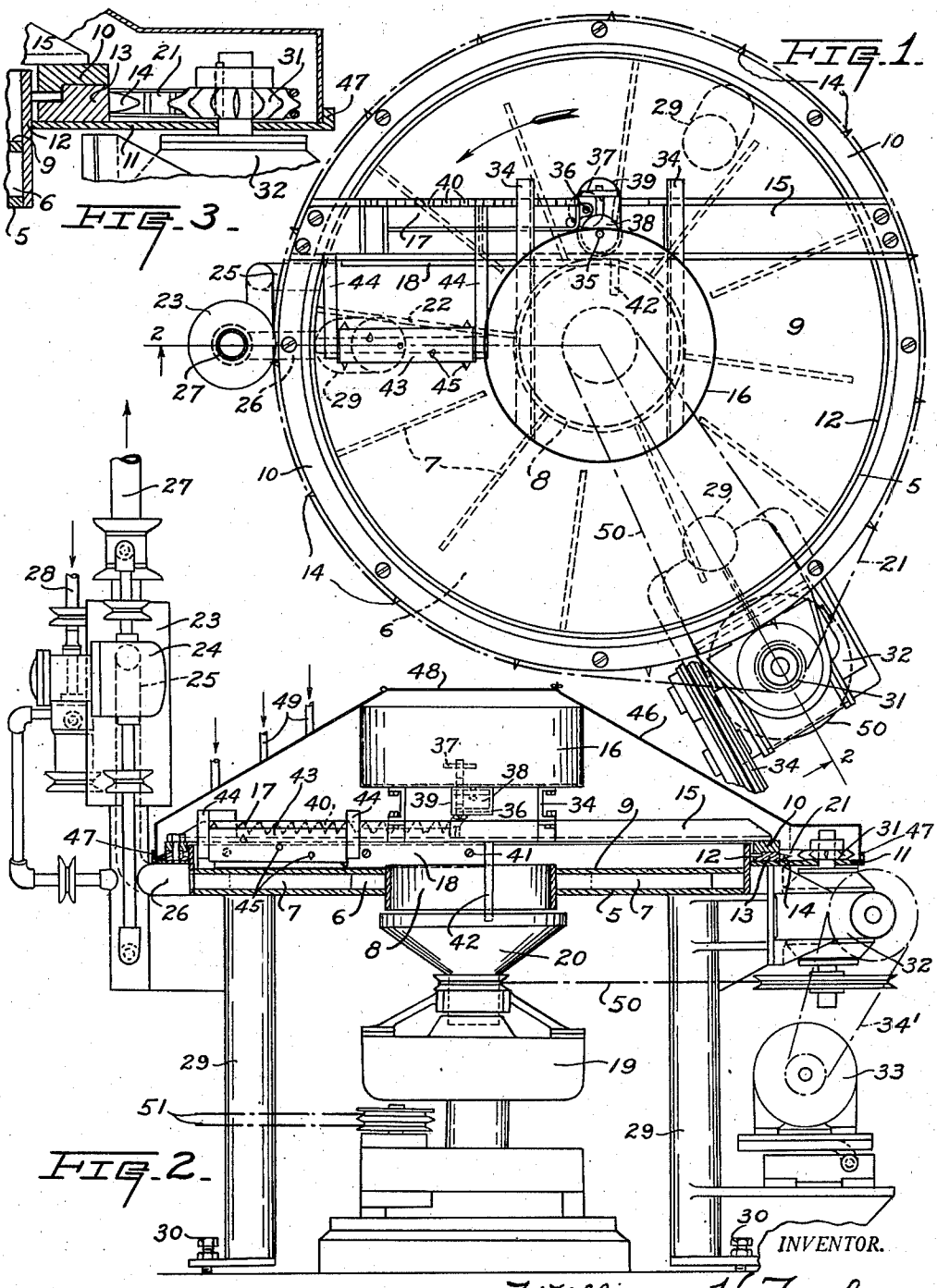

FIG. 1.

FIG. 3.

FIG. 2.

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SLUSH ICE MAKING MACHINE

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1

The present invention relates generally to improvements in the art of refrigeration, and relates more specifically to improvements in the construction and operation of mechanism for continuously producing so-called slush or snow ice.

The primary object of my present invention is to provide a new and useful ice making machine which is simple in construction and highly efficient in operation.

Many different types of mechanisms intended for more or less continuous and automatic production of slush, flake or snow ice, have heretofore been proposed and used commercially with varying degrees of success; and while some of these prior ice making machines are quite efficient for general use, they require the addition of special and rather complicated transfer and feed mechanisms when it is desired to continuously deliver the product to an extractor such as a centrifuge for subsequently removing excess liquid from the ice. Most of the prior slush ice producers are also quite cumbersome and complicated and are not adapted to produce large quantities of uniform product with limited refrigeration, thereby excessively increasing the cost of artificial production of the ice.

It is therefore a more specific object of my invention to provide an improved artificial ice producing mechanism, which besides being relatively simple and compact in construction, is adapted to automatically and continuously deliver the slush ice through a relatively small discharge opening to a constantly functioning excess liquid extractor or the like.

Another specific object of the present invention is to provide an improved continuous ice producing unit having large capacity considering the space occupied, and all parts of which are readily accessible for inspection.

A further specific object of this invention is to provide various improvements in the details of construction of continuous ice making machines, whereby manufacture thereof is simplified, while the cost of installation and operation is minimized.

Still another specific object of the invention is to provide an improved slush ice producer which is durable in construction, readily controllable, and safely operable, while producing uniform and excellent product.

2

These and other specific objects and advantages will be apparent from the folowing detailed description.

A clear conception of the various features constituting my present invention, and of the mode of constructing and of operating ice making machines built in accordance therewith, may be had by referring to the drawing accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the different views.

Fig. 1 is a somewhat diagrammatic top view of one of the improved ice making machines, with the normal enclosing cover for the freezing zone removed;

Fig 2 is a similarly diagrammatic vertical section through the machine of Fig. 1, taken along the irregular line 2—2; and

Fig. 3 is an enlarged fragmentary vertical section taken vertically through the periphery of the unit adjacent to the main drive.

While the invention has been shown and described herein as having been specifically embodied in an automatic and continuous slush ice producer associated with an excess liquid removing centrifuge to provide a single combined ice producing and liquid extraction unit, it is not my desire or intention to thereby unnecessarily restrict the scope of utility of the improved freezer.

Referring to the drawing, the improved ice making and excess liquid removing unit shown by way of illustration, comprises in general, a stationary circular slab freezer casing 5 forming an annular refrigerant confining chamber 6 having a series of radial baffles 7 therein, and being provided with a fixed central discharge spout 8 the upper extremity of which terminates slightly above the horizontal upper freezing surface 9 of the casing 5; an annular revolving element or ring 10 rotatably supported upon a fixed annular plate 11 surrounding and secured to the outer or peripheral wall 12 of the casing 5, and having a lower section 13 provided with an annular series of equally spaced driving projections or teeth 14; a cross-beam or channel 15 mounted upon the revolving ring 10 and providing a rotary support for a central liquid supply tank 16, a liquid feed pan 17, and a scraper blade 18, the latter coacting with the freezing surface 9

and terminating tangentially relative to the central cylindrical discharge spout 8; an excess liquid remover or centrifuge 19 disposed centrally beneath the slush ice discharge spout 8 and communicating therewith through an intervening funnel or hopper 20; mechanism including a chain drive 21 for normally slowly revolving the ring 10 with its associated tank 16, feed pan 17, and scraper blade 18; other driving mechanism for the centrifuge 19; and still other mechanism for insuring constant circulation of refrigerant through the annular chamber 6.

The stationary slab freezer casing 5, baffles 7, spout 8, and bearing plate 11 may all be formed of sheet metal plates welded together so as to produce a rigid structure and a hermetically sealed chamber 6, and this chamber 6 is provided with a radial partition 22. The refrigerant may be supplied and circulated through the chamber 6 and around the baffles 7 from any suitable source, and as shown in the drawing, the refrigerant circulating mechanism comprises a refrigerant accumulator 23 having an ordinary float control valve 24 associated therewith, and being provided with a suction connection 25 communicating with the chamber 6 on one side of the partition 22, and with a liquid refrigerant supply connection 26 communicating with this chamber 6 on the opposite side of the same partition 22. The suction connection 25 communicates through the upper portion of the accumulator 23 with a suction line 27 leading to the gas compressor, not shown, while the refrigerant inlet or supply connection communicates with the inlet line 28 through the lower portion of the accumulator 23 and past the control valve 24, and the other details of construction and operation of the refrigerant circulating mechanism should be clearly apparent to those skilled in the art and constitute no special part of my present improvement.

The annular freezer casing 5 and bearing plate 11, may be firmly supported in horizontal position above the centrifuge 19 and funnel 20 by means of three or more upright columns 29, and these may be provided with adjustable jack screws 30 for leveling the freezing surface 9. The accumulator 23 and other refrigerant circulating mechanism may also be suspended from one of the columns 29 as shown in Fig. 2, and the use of these spaced local columns also permits free access to the centrifuge 19 and to the underside of the ice making machine at all times. As previously indicated, the composite rotor ring 10 has a lower annular section 12 provided with a series of teeth 14 which coact with a driving chain 21, and this chain may be constantly driven at relatively slow speed by means of a pinion 31 driven through speed reducing mechanism 32 from a main driving motor 33 and belt drive 34' all of which may also be suspended from one of the supporting columns 29 as shown.

The constantly functioning ice removing rotor which comprises the rotor ring 10 and the elements carried thereby, is thus constantly revolvable about the central vertical axis of the machine upon the fixed bearing plate 11, and the fixed annular casing wall 12 serves to maintain the rotor ring 10 centralized. The fresh liquid supply tank 16 may be firmly supported from the rotor cross-channel 15 by means of a pair of I-beams 34; and the tank 16 is provided with a lower outlet port 35 which communicates with the liquid feed pan 17 past adjustable flow regulating mechanism consisting of a needle valve 36 adapted to be set or manually adjusted with the aid of a dial wheel 37, and which is normally automatically operable by a float 38 confined within a chamber 39 suspended from the lower portion of the supply tank 16. While any suitable type of liquid flow or feed regulating mechanism may be utilized, this mechanism should be adapted to constantly deliver a predetermined amount of liquid from the supply tank 16 to the pan 17. The feed pan 17 which is supported by the cross-beam 15, extends along this beam from a point adjacent the periphery of the spout 8 to a point near the annular wall 12 of the casing 5; and the rear or trailing wall of the pan 17 is provided with a series of notches 40 through which the fresh liquid flows onto the freezing surface 9 and is distributed uniformly thereover as the rotor constantly revolves.

The feed pan 17 is supported upon the channel beam 15 rearwardly of the scraper blade 18 which is likewise attached to this beam and extends from a point of tangency with the discharge spout 8 to a point closely adjacent to the outer wall 12 of the slab freezer casing 5, and the lower edge of the blade 18 should be disposed in close proximity and parallel to the freezing surface 9. The scraper blade 18 is preferably vertically adjustable relative to the ice forming surface 9, by means of fastening screws 41 coacting with slots in the blade 18 and with the front or leading wall of the cross-channel 15, and the blade 18 normally revolves with the rotor ring 10 and constantly scrapes the ice which forms upon the surface 9 and conveys the removed flake or slush ice inwardly toward and into the discharge spout 8, by virtue of its tangential disposition relative to this spout. In order to prevent accumulation of ice within the fixed spout 8 at the inner end of the scraper blade 18, an auxiliary scraper 42 which coacts with the inner surface of the annular spout 8 is also provided, and this auxiliary scraper 42 also normally revolves with the main scraper 18 and ring 10 and operates in close proximity to the inner cylindrical surface of the spout 8.

In order to additionally support the cross-beam 15 and to initially break up or loosen the sheet of ice which is constantly formed upon the freezing surface 9 in advance of the revolving scraper blade 18, a disintegrating roller 43 may also be provided. This roller 43 is rotatably suspended from the rotor cross-beam 15 by means of spaced parallel brackets 44 extending forwardly beyond the scraper blade 18, and the roller 43 is provided with a series of peripheral points or spuds 45 which dig into the ice and rotate the advancing roller 43 as the rotor and blade 18 revolve. This roller 43 thus loosens the ice coating preparatory to removal thereof from the surface 9, and also lends support to the cross-beam 15 directly in advance of the scraper blade 18, thereby avoiding possible undesirable chattering of this blade.

The entire rotor mechanism may also be enclosed within a readily removable normally fixed housing 46 which rests upon the fixed rotor supporting plate 11 within the peripheral flange 47 thereof, and this housing 46 is provided with a readily removable closure or cover 48 at its upper central portion, for permitting convenient filling of the fresh liquid supply tank 16. This housing 46 and cover 47, also totally conceal the freezing zone, and may be provided with a plurality of gas injection nozzles 49 as shown in Fig. 2. These nozzles 49 are directed downwardly against the

freezing surface 9 and may be utilized to deliver jets of air or nitrogen or other gas, against the fresh liquid which is constantly being deposited upon the freezer casing 5, so as to agitate and uniformly distribute the fresh liquid throughout the entire area of the surface 9. If so desired, the gas thus injected into the freezing zone may be re-circulated through the nozzles 49 in order to eliminate loss of energy, and the housing 46 and cover 48 may also be formed of sheet metal and should be readily removable so as to permit ready access to the rotor, driving mechanism, and surface 9.

As shown in the drawing, the central discharge chute or spout 8 of the ice producing machine, is adapted to constantly deliver the product through a hopper or funnel 20 to an excess liquid extractor or centrifuge 19; and in order to insure uniform distribution and delivery of the ice to the extractor, the funnel 20 may also be slowly revolved about the central axis of the unit with the aid of a flexible belt drive 50 driven by the motor 33 through the same speed reducer 32 which imparts slow motion to the rotor ring 10. The centrifuge 19 may be of any suitable type preferably adapted to constantly and automatically dehydrate the slush ice, and this extractor or centrifuge may be driven from any suitable source by means of flexible belt or other drives 51 extending through the space between the supporting columns 29.

After the ice producing unit has been properly constructed, assembled and adjusted, it may be placed into continuous and automatic normal operation in order to constantly produce flake or slush ice of uniform consistency at a rapid rate, as follows. As the rotor is constantly revolved at a relatively low rate of speed by means of the electric motor 33 coacting with the gear reducer 32, the scraper blade 18 continuously advances over the freezing surface 9 in the direction of the arrow shown in Fig. 1. Fresh liquid is constantly being delivered at a predetermined rate from the supply tank 16 through the orifices 35 and past the needle valve 36 to the feed pan 17, and is delivered from this pan 17 past the feed grooves 40 onto the freezing surface 9 throughout the entire area thereof. Refrigerant is being constantly fed into the chamber 6 through the supply connection 26 on one side of the partition 22, and after flowing circuitously past the baffles 7, the gaseous refrigerant is withdrawn from the chamber 6 on the other side of the partition 22 through the connection 25. The surface 9 is thus maintained at freezing temperatures at all times, and the fresh liquid deposited upon this surface 9 from the pan 17 past the grooves 40 is obviously frozen into a layer or film of ice extending throughout the entire area of the freezing surface. The constantly advancing spiked roller 43 initially loosens and disintegrates this ice sheet or film, and the constantly advancing scraper blade 18 removes the slush ice from the surface 9 and conveys the same into the discharge chute 8. The auxiliary scraper 42 which is revolving with the scraper rotor, constantly urges the removed slush ice downwardly through the chute 8 and prevents the product from accumulating on the inner surface of the chute, and the slush ice subsequently passes through the funnel 20 and into the extractor or centrifuge 19 where the excess liquid is removed therefrom. The finally dehydrated product may be discharged from the centrifuge 19 to any suitable zone of utilization, and the machine thus functions to

automatically and continuously produce the product. In order to uniformly spread the fresh liquid throughout the entire area of the freezing surface 9, gas may be injected against the fresh liquid through the nozzles 49, and the needle valve 36 may also be readily adjusted so as to insure proper feeding of fresh liquid to the pan 17 and freezing surface 9. If it becomes desirable to inspect any portion of the ice producing mechanism, the housing 46 may be readily removed, and fresh liquid may be conveniently admitted to the tank 16 by merely opening the cover 48.

It will thus be noted that the present invention provides an extremely simple, compact and durable ice making machine which functions to constantly and automatically produce a uniform product, and which is also safely operable. The improved slab freezing assemblage enables the product to be continuously and quickly conveyed into a central relatively small delivery spout 8, from whence the slush ice may be effectively discharged by gravity into a centrifuge or the like, thus eliminating complicated intervening feed mechanisms. While the revolution of the rotor is at a relatively slow rate, the capacity of the machine is nevertheless great because of the large freezing surface 9 traversed by the scraper blade, and the tangential disposition of the blade 18 relative to the discharge chute 8, provides simple and effective means for continuously discharging the product from the freezing surface. The use of the spiked roller 43 in advance of the scraper blade 18 is also advantageous since it permits more effective removal of the ice film by the scraper, and the provision of the auxiliary scraper 42 within the chute 8 will obviously avoid undesirable accumulation of ice at the inner end of the scraper blade. The baffles 7 within the chamber 6, insure uniform distribution of the refrigerant and most efficient utilization thereof, and also insures the production of a uniform ice film, and the entire mechanism is of excedingly simple but sturdy construction and may be manufactured and operated at minimum cost. The invention has proven highly successful in actual use, and has demonstrated the fact that a compact unit of the improved type can produce enormous quantities of uniform slush ice with minimum attention and at moderate cost.

It should be understood that it is not desired to limit this invention to the exact details of construction or to the precise mode of operation, herein shown and described, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

I claim:

1. In combination, a casing having a flat annular freezing surface, means for constantly maintaining said surface at freezing temperature, means for constantly feeding liquid upon and throughout the area of said surface, and a constantly revolving scraper for planing the congealed liquid from the surface and for conveying the removed product toward the center of the annulus.

2. In combination, a casing having a flat annular freezing surface, means for constantly maintaining said surface at freezing temperature, revolving means for constantly feeding liquid upon and throughout the area of said surface, and a constantly revolving scraper for constantly planing the congealed liquid from the surface and for conveying the removed product toward the center of the annulus.

3. In combination, a casing having an annular

horizontal plane freezing surface and a refrigerant confining chamber adjoining said surface, means for constantly circulating refrigerant through said chamber, a scraper constantly revolvable over said surface to plane the congealed liquid therefrom, and means directly adjacent to and revolvable with said scraper for constantly feeding liquid to said surface.

4. In combination, a casing having an annular horizontal plane freezing surface and a refrigerant confining chamber adjoining said surface, means for constantly circulating refrigerant through said chamber, means for constantly feeding liquid to said surface, means for delivering gas jets against said liquid to agitate and distribute the same throughout the entire area of said surface, and a scraper constantly revolvable over said surface to plane the congealed liquid therefrom.

5. In combination, a casing having a flat annular freezing surface, means for constantly maintaining said surface at freezing temperature, revolving means for constantly feeding liquid upon and throughout the area of said surface, a disintegrating roller revolvable over said surface and coacting therewith to loosen the ice film formed thereon, and a scraper blade directly adjacent to and trailing said roller and being revolvable therewith over said surface to remove the ice loosened by said roller.

6. In combination, a casing having an annular approximately horizontal plane freezing surface, means for maintaining said surface at freezing temperature, means for constantly feeding liquid upon said surface, means for loosening the congealed liquid film formed on said surface, and means for constantly removing the loosened film and for conveying the same toward the center of the annulus.

7. In combination, a casing forming an annular refrigerant confining chamber having therein a series of radial baffles and being provided with a flat annular freezing surface adjoining the chamber, means for circulating refrigerant through said chamber, means for feeding liquid over said surface, and a scraper revolvable over said surface and being formed to remove congealed liquid from the surface and centrally through said chamber.

8. In combination, a fixed casing forming a refrigerant confining chamber and having an annular freezing surface adjoining the chamber, means for circulating refrigerant through said chamber to cool said surface, and a rotor constantly revolvable adjacent to said surface and having revolvable means for feeding liquid to said surface and a scraper for constantly removing congealed liquid from the surface and centrally through said chamber.

9. In combination, a fixed casing having a flat annular freezing surface surrounded by an annular wall and communicating inwardly with a central chute, a rotor coacting with said casing and being revolvable about said casing wall, means carried by said rotor for delivering liquid to said surface, and means also carried by said rotor for constantly scraping congealed liquid from said surface and for delivering the product through said chute.

10. In combination, a fixed casing having a flat annular freezing surface surrounded by an annular wall and communicating inwardly with a central chute, a rotor coacting with said casing and being revolvable about said casing wall, means carried by said rotor for delivering liquid

to said surface, means for loosening the film of congealed liquid constantly forming upon said surface, and means also carried by said rotor for constantly scraping congealed liquid from said surface and for delivering the product through said chute.

11. In combination, a fixed casing having a flat annular horizontal freezing surface surrounded by an annular wall and communicating inwardly with a central chute, a ring surrounding and being revolvable about said wall, a liquid supply tank carried by and being rotatable with said ring, and a scraper blade also carried by said ring and being revolvable over said surface to remove congealed liquid therefrom and to deposit the product into said chute.

12. In combination, a fixed casing having a flat annular horizontal freezing surface surrounded by an annular wall and communicating inwardly with a central chute, a ring surrounding and being revolvable about said wall, a liquid supply tank carried by and being rotatable with said ring, a scraper blade also carried by said ring and being revolvable over said surface to remove congealed liquid therefrom and to deposit the product into said chute, and a scraper carried by said ring and coacting with said chute at the inner end of said blade.

13. In combination, a fixed casing having a flat annular freezing surface and a discharge chute at the center thereof, means for cooling said surface, a ring revolvable about said surface, a liquid feed pan carried by said ring and having a wall formed to deliver liquid over the entire area of said surface, and a scraper blade carried by said ring and being revolvable over said surface to remove congealed liquid therefrom and to deliver the product into said chute.

14. In combination, a fixed casing having a flat annular freezing surface and a discharge chute at the center thereof, means for cooling said surface, a ring revolvable about said surface, a liquid feed pan carried by said ring and having a wall provided with a series of liquid delivery notches formed to deliver fresh liquid over the entire area of said surface, and a scraper blade carried by said ring and being revolvable over said surface to remove congealed liquid therefrom and to deliver the product into said central chute.

15. In combination, a fixed casing having a flat annular freezing surface and a discharge chute at the center thereof, means for cooling said surface, a ring revolvable about said surface, a liquid feed pan carried by said ring and having a wall provided with a series of liquid delivery notches formed to deliver fresh liquid over the entire area of said surface, means for delivering jets of gas against the liquid deposited upon said surface, and a scraper blade carried by said ring and being revolvable over said surface to remove congealed liquid therefrom and to deliver the product into said central chute.

16. In combination, a fixed casing having a flat annular freezing surface and a discharge chute at the center thereof, means for cooling said surface, a ring revolvable about said surface, a liquid feed pan carried by said ring and having a wall provided with a series of liquid delivery notches formed to deliver fresh liquid over the entire area of said surface, a disintegrating roller carried by said ring and coacting with the film of congealed liquid formed upon said surface, and a scraper blade carried by said ring and being revolvable over said surface to remove congealed liquid

therefrom and to deliver the product into said central chute.

17. In combination, a casing having a flat annular freezing surface, means for constantly maintaining said surface at freezing temperature, means for constantly feeding liquid to said surface, a disintegrating roller revolvable over said surface and coacting therewith to loosen the ice film formed thereon, said roller being disposed in a plane radially of the axis of the annulus, and a scaper blade trailing said roller and being revolvable over said surface to remove the loosened ice, said scraper being disposed in a plane parallel to the axis of said roller.

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