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(54) APPARATUS FOR THE PRODUCTION OF GRANULATED PRODUCTS

(71) We, VSESOJUZNY-NAUCHNO-ISSLEDOVATELSKY I EXPERIMENTALNO-KONSTRUKTORSKY INSTITUT PRODOVOLSTVENNOGO MASHINOSTROENIA (VNIEKIPRODMASH) of 1 prospekt Marsahla, Zhukova, Moscow, Union of Soviet Socialist Republics (U.S.S.R.) and INSTITUT ELEMENTOORGAN-ICHESKIKH SOEDINENY AKADEMII NAUK SSSR of 28 utitsa Vavilova, Moscow, U.S.S.R. both State Enterprises organised and existing under the laws of the U.S.S.R. do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to food industry equipment, and more particularly to installations for the production of granulated products from the solutions or the suspensions of food substances.

The present invention is particularly adapted for use in the production of granulated food products, preferably imitation soft caviar.

According to the present invention there is provided an apparatus for producing a granular food product from a liquid solution or suspension thereof including a chamber for holding the solution or suspension and having an apertured base plate, means for heating the chamber, means for pressurising the chamber; within the chamber a rotatable disc contiguous with the base plate and having a series of apertures located so as to register with apertures in the base plate during rotation of the disc; and means for rotating the disc, a heat-insulating spacer plate abutting the base plate external the chamber, a plurality of nozzles extending through and projecting below the spacer plate, each nozzle registering with an aperture of the base plate; a plurality of elongate tubes located below the spacer plate each tube being aligned with a nozzle, and positioned so that an end portion of each nozzle extends into a tube, the relative diameter of nozzle and tube being such that an annular gap is formed between the end portion of the nozzle and the tube, and heat exchange means for cooling the tubes, means for supplying forming liquid into the tube via the annular gap: and means for removing formed granules from the tubes.

This apparatus makes it possible to carry out granule forming without heating the forming liquid in the granules forming zone and employs the forming liquid flow for carrying away granules from the forming zone. The provision of forced conveyance of granules by the flow of cool forming liquid uniformly streaming past each of the nozzles via the annular gaps and taking each metered drop off the nozzle precludes any possibility of collision and coalescence of successive non-congealed granules. The arrangement of each current of granules formed from metered drops which escape from one and the same nozzle inside the same tube of the heat exchanger precludes collision and coalescence of granules coming out of neighbouring nozzles. All this permits an increase in the output of the granules forming apparatus.

The provision of forced conveyance of formed granules along the heat-exchanger tubes also improves heat transfer, which makes it possible to reduce the amount of forming liquid in the vessel considerably and at the same time to attain uniform and equal cooling and hardening of all granules, and hence to achieve a high quality of the product. Since the forming liquid within the forming zone of the vessel is not heated, the circulating forming liquid may be fed directly into that zone. The provision of a heat-insulating spacer plate between the heat chamber and cold heat exchanger makes it possible to keep the forming liquid under a comparatively low temperature, which in turn precludes partial dissolving of the granular food substances in the forming liquid, thereby maintaining their food value and preventing deterioration of the forming liquid, thus increasing its life time with a resultant reduction of the consumption of the forming liquid.

Reduced amount of the forming liquid and forced conveyance of granules along the heat-exchanger tubes make it unnecessary to "saturate" the vessel contents with granules, at the same time providing a uniform evacuation of granules from the device in the start-off periods and contributing to a more complete utilization of the produced granules with a resultant material increase in the efficiency of the device.

Preferably, the plurality of tubes are held in an end plate abutting the spacer plate and a cavity is formed in the face of the end plate adjacent the spacer plate so as to provide fluid communication with each annular gap and the means for supplying forming liquid.

The provision of said cavity offers the possibility of uniformly supplying the forming liquid into the heat-exchanger tubes and helps to maintain a uniform velocity of the forming liquid flow in the tubes. Furthermore, a uniform and similar flowing-around of the nozzles with the forming liquid passing through the annular gaps provides a laminar flow of the forming liquid in the tubes, thereby providing a rapid conveyance of formed granules from the nozzles, precluding their collision and coalescence, thus ensuring the production of uniformly sized conglobate granules and contributing to a still further increase in the output of the granules forming device and in the quality of the product.

In a preferable alternative apparatus the spacer plate has a recess in fluid communication with the annular gap between each tube and nozzle and with the means for supplying forming liquid so that forming liquid is supplied to the recess and is distributed to each tube.

As a further equally preferable alternative said cavity machined in the end plate is coextensive with the registers with a recess made in the spacer plate.

Preferably the end portion of each nozzle tapers towards the tube and the adjacent mouth portion of the tube is flared toward the nozzle with the annular gap therebetween.

However, the nozzles and the tubes can be of cylindrical shape.

Advantageously the tubes are enclosed by a vessel providing a shell provided with means for circulation of a coolant.

Such a configuration and arrangement of the nozzles and the upper ends of the tubes help to maintain a constant preset temperature of the forming liquid circulating via the heat-exchanger tubes, which is essential for transformation of liquid protein into gel.

Given below is a detailed description of the device for the production of granulated products from solutions or suspensions of food substances; the invention will be readily understood from the detailed description, in which reference will be made to the accompanying drawings, wherein;

Fig. 1 is a schematic view of the device for the production of granulated products from solutions or suspensions of food substances used in the invention (vertical sectional view);

Fig. 2 is an enlarged fragmentary sectional view of the nozzle and tube upper end of the cylindrical tubular heat exchanger, used in this invention;

Fig. 3 is an enlarged fragmentary sectional view of the cavity formed in the heat-insulating spacer, used in this invention;

Fig. 4 is an enlarged fragmentary sectional view of the cavity formed partially in the flange and partially in the heat-insulating spacer, used in this invention.

The apparatus for the production of granular food products from solutions or suspensions of food substances comprises a heated chamber 1 (Fig. 1) for accommodation and pressure-controlled feed of said solutions or suspension, which has an apertured base plate 5, a top plate 2 provided with an inlet pipe 3 for feeding the solutions or the suspensions into the chamber 1 under pressure. Externally, said chamber 1 has an annular void 4 (as shown in Fig. 1) for circulation of a heat-carrying agent. The base plate 5 of the chamber is provided with along a circumference equally spaced apertures 6 intended for discharging the solution or the suspension of food substances from the chamber 1. Within the chamber 1 is a rotatable disk 7 contiguous with the base plate 5 of the chamber. The disk 7 is suitably secured to a shaft 8 connected to a drive means 9, which is installed outside the chamber 1. The drive means 9 can be of any known design appropriate for the purpose. A spring 10 is arranged under compression on the shaft 8 inside said chamber between the top plate 2 and disk 7 to urge the latter to be in close contact with the base plate 5 of the chamber 1. The mating surfaces of the disk 7 and base plate 5 are flat, but they may be of any other shape, tapered and spherical configurations included (not shown in Fig. 1). The spring-urged disk 7 is held in close contact with the base plate 5, thereby precluding penetration of the solution or the suspension between the parts. The disk 7 also has equally spaced apertures 11 along a circumference, which during rotation of the disk 7 register with the apertures 6 in the base plate 5. Arranged under the chamber 1 is a vessel filled with forming liquid and granules from the solution or the suspension. The vessel is made in the form of a tubular heat exchanger 12 attached to the base plate 5 of the chamber 1 through the medium of a heat-insulating spacer plate 13.

The heat exchanger 12 comprises a shell 14 and a plurality of tubes 15 installed vertically inside the shell. The number of the tubes 15 is equal to the number of the apertures 6 in the base plate 5. The shell 14 of the heat exchanger 12 is fashioned as a cylinder vertically installed and hermetically sealed at its ends. The shell 14 is adapted for circulation of a cooling agent. Provided in the cylindrical wall of the shell 14 near its ends are inlet and outlet pipes 16, one for delivery and the other for discharge of the cooling agent circulating via the shell 14. In the top end face of the shell 14 are holes through which the upper ends of the tubes 15 are passed. The lower end face of the shell 14 has similar holes for receiving the lower ends of the tubes 15.

Arranged externally from the lower end face of the shell 14 and tightly fitted to the lower end face of the shell is a tapered bottom 16*a* converging downwards (as shown in Fig. 1) and terminating in a central outlet hole. Thus, each tube 15 communicates with the interior space of the tapered bottom 16*a*. A flange 17 made in the form of a disk and adjoining the heat-insulating spacer plate 13 from below is fixed together with the latter to the base plate 5, as shown in Fig. 1. The flange 17 also has through holes to receive the upper ends of the tubes 15 arranged in axial alignment with the apertures 6 in the base plate 5 of the chamber 1.

The heat-insulating spacer plate 13 abutting the base plate 5 external the chamber 1 has a plurality of nozzles 18 extending through and projecting below the spacer plate 13, each nozzle 18 registering with an aperture 6 in the base plate 5 of chamber 1. The elongate tubes 15 are located below the spacer plate 13 so that each tube 15 is aligned with a nozzle 18 and positioned so that an end portion of each nozzle 18 extends into a tube 15, the relative diameter of the nozzle 18 and the tube 15 being such that an annular gap 20 is formed between the end portion of the nozzle 18 and the tube 15.

The end portion of each nozzle 18 tapers towards the tube 15 and the adjacent mouth portion of the tube is flared towards the nozzle with the annular gap 20 therebetween, as shown in Fig. 1. This configuration of the annular gap 20 is the optimim for maintaining a laminar flow of the forming liquid in the tubes 15.

The nozzles 18 of the heat-insulating spacer plate 13*a* and upper ends of the tubes 15, as shown in Fig. 2, may be cylindrical. In this case each annular gap 20 between the parts is also cylindrical.

Formed between the heat-insulating spacer plate 13 (or 13*a*) and flange 17 is a cavity 21 intercommunicating the tubes 15. The cavity 21 is formed by a cylindrical recess 22 in the flange 17 on the side opposing the heat-insulating spacer plate 13 (or 13*a*), as shown in Figs 1 and 2. The recess 22 is machined so that the holes in the flange 17 receiving the upper ends of the tubes 15 communicate with the cavity 21, as illustrated in Figs 1 and 2. The depth of the recess 22 is somewhat less than the length of the nozzles 18 (or 18*a*).

Referring to Fig. 3, the cavity 21 is formed by a cylindrical recess 23 made in the heat-insulating spacer 13 on the side facing the flange 17. The diameter of the recess 23 is greater than the distance between the outermost points of the nozzles 18, and a gap is formed between the nozzles 18 and the recess periphery. The height of the recess 23 is somewhat less than the length of the nozzles 18.

Referring to Fig. 4, the cavity 21 is formed partially by a recess 22 and partially by a recess 23. The height of the cavity 21 is somewhat less than the length of the nozzles 18.

The flange 17 is provided with a central hole, in which a pipe 24 (Fig. 1) is fixed to feed the forming liquid into the cavity 21 and to provide communication between the pipe and the tubes 15 via said cavity 21 and gaps 20.

The proposed apparatus for the production of granulated products is provided with a pipe 25 for discharging the forming liquid together with the formed granules from the heat exchanger 12. One end of the pipe 25 is secured in the central hole of the tapered bottom 16*a*, the other end of the pipe is brought to the device 26 which separates granules from the forming liquid supplied from the heat exchanger. The device 26 is in communication with the heat exchanger 12 via the pipe 24 returning the forming liquid to the heat exchanger. Installed in the line of the pipe 24 is a pump 27 providing circulation of the forming liquid within the following closed circuit: pipe 24, heat exchanger 12, pipe 25, device 26. The pump 27 can be of any known type suitable for the purpose.

The device for the production of granulated products from the solutions or the suspensions of food substances operates as follows.

The heat exchanger 12, pipes 24 and 25 and the device 26 are filled with the forming liquid wherein granules are formed. Used as such medium is a vegetable or mineral oil, for instance, sunflower or corn oil, or medical grade paraffin oil.

A coolant is fed into the shell 14 of the heat exchanger 12 to cool the forming liquid to a preset temperature. The void 4 of the chamber 1 is fed with a heating medium to raise the temperature of the chamber 1 to the predetermined value.

The preheated solution or suspension of the food substances is supplied under pressure into the heated chamber 1 through the inlet pipe 3. The drive means 9 must be actuated to gradually vary the rotational speed of the shaft 8. The shaft 8 imparts the desired rotation to the disk 7. The matching of the apertures 11 in the disk 7 with the apertures 6 in the base plate 5 results in filling the apertures holes 6 and passages 19 of the nozzles 18 (Fig. 1) or 18*a* (Fig. 2) with controlled portions of the prepared solution or suspension. Compressed air fed into the chamber 1 forces the solution or the suspension portions from the chamber into the respective tubes 15 filled with the forming liquid. The forced delivery of the solution or the suspension of the food substances from the chamber 1 via said apertures 6 and passages 19 lasts for the time period, during which the apertures 11 in the disk register with the apertures 6 in the base plate 5. As soon as the apertures 6 are closed completely by the rotating disk 7, the solution or the suspension stops flowing out of the chamber 1. The portions of the solution or the suspension leave the passages 19 of the nozzles 18 (or 18*a*) in the shape of metered drops 28 and fall into the forming liquid. The metered drops 28 are taken from the nozzles 18 (or 18*a*) by the forming liquid flowing past the nozzles 18 (or 18*a*) and under the action of the surface tension forces assume a ball-like shape.

As the ball-like metered drops 28 are carried by the forming liquid flowing along tubes 15 to the lower part of the heat exchanger, they are cooled and transformed from the liquid ball-like drops into granules of hard gel.

The formation of granules takes place in all the tubes of the heat exchanger in a similar way as a result of successive matching of the apertures 11 in the disk with the apertures 6 in the base plate 5 of the chamber 1 during rotation of the disk 7.

Granules carried down tubes 15 by the forming liquid flow into the tapered bottom 16*a* from the tubes 15 are further taken by the liquid into the pipe 25 and therefrom into the arrangement 26 where separation of granules from the forming liquid takes place. The separated granules are fed for further treatment, whereas the forming liquid returns into the cavity 21, via the pipe 24, to flow further through the gaps 20 into the tubes 15. Thus, a continuous process of the production of granules from the solution of the suspension of food substances occurs in the granules forming device. To stop the operation of the device, it is sufficient to cut off the supply of the solution or the suspension into the chamber 1, cut out the drive 9 and stop the disk 7. All formed granules will be carried from the tubes 15 of the heat exchangee 12 and tapered bottom 16a by the forming liquid flow into the arrangement 26 to get separated from the forming liquid. Then drain the forming liquid from the granules forming device, cut out the pump 27 and perform sanitary treatment of the device.

WHAT WE CLAIM IS:-

1. Apparatus for producing a granular food product from a liquid solution or suspension thereof including a chamber for holding the solution or suspension and having an apertured base plate, means for heating the chamber, means for pressurising the chamber; within the chamber a rotatable disc continguous with the base plate and having a series of apertures located so as to register with apertures in the base plate during rotation of the disc; and means for rotating the disc, a heat-insulating spacer plate abutting the base plate external the chamber, a plurality of nozzles extending through and projecting below the spacer plate, each nozzle registering with an aperture of the base plate; a plurality of elongate tubes located below the spacer plate each tube being aligned with a nozzle, and positioned so that an end portion of each nozzle extends into a tube, the relative diameter of nozzle and tube being such that an annular gap is formed between the end portion of the nozzle and the tube, and heat exchange means for cooling the tubes, means for supplying forming liquid into the tube via the annular gap; and means for removing formed granules from the tubes.

2. Apparatus according to claim 1, in which the spacer plate has a recess in fluid communication with the annular gap between each tube and nozzle and with the means for supplying forming liquid, so that forming liquid is supplied to the recess and is distributed to each tube.

3. Apparatus according to claim 1 in which the plurality of tubes are held in an end plate abutting the spacer plate and a cavity is formed in the face of the end plate adjacent the spacer plate so as to provide fluid communication with each annular gap and the means for supplying forming liquid.

4. Apparatus according to claim 2 and 3 in which the cavity in the end plate is coextensive with the registers with the recess in the spacer plate.

5. Apparatus according to any preceding claim in which the end portion of each nozzle taper toward the tube and the adjacent mouth portion of the tube is flared toward the nozzle with the annular gap therebetween.

6. Apparatus according to any one of claims 1 to 4, in which the nozzles and the tubes are of cylindrical shape.

7. Apparatus according to any preceding

claim, in which the tubes are enclosed by a vessel providing a shell provided with means for circulation of a coolant.

8. Apparatus for providing granular food product substantially as hereinbefore described with reference to and as shown in Figs. 1 to 4 of the accompanying drawings.

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1565723 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

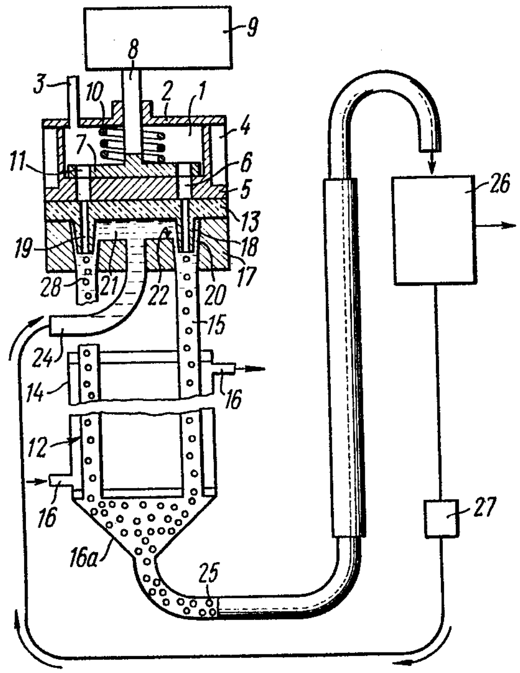

FIG.1

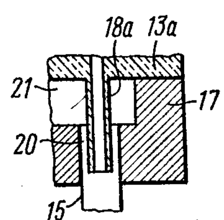

FIG.2

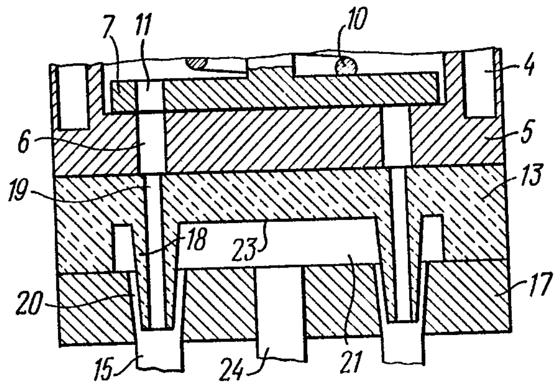
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FIG.3

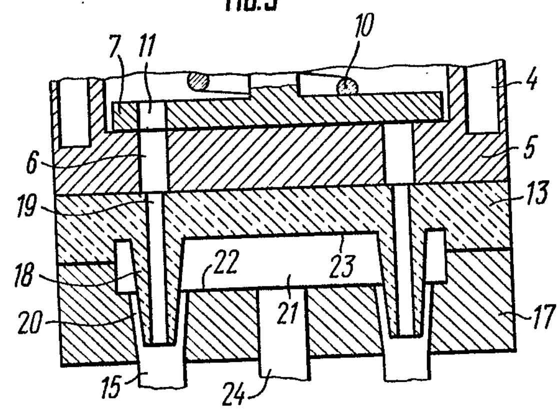
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FIG.4