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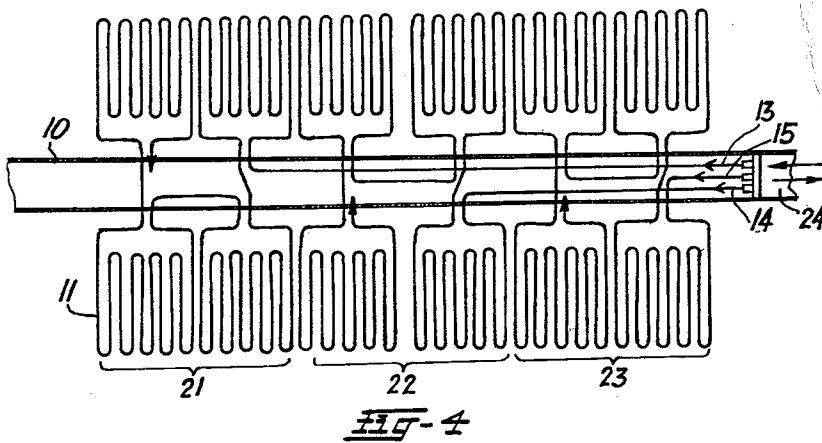
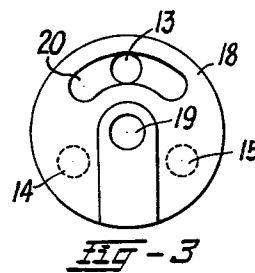
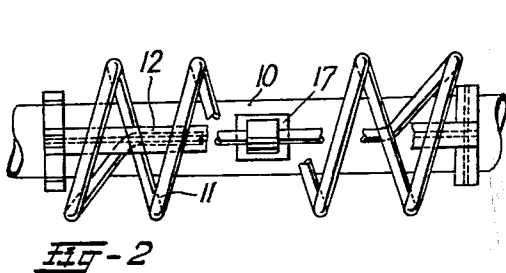
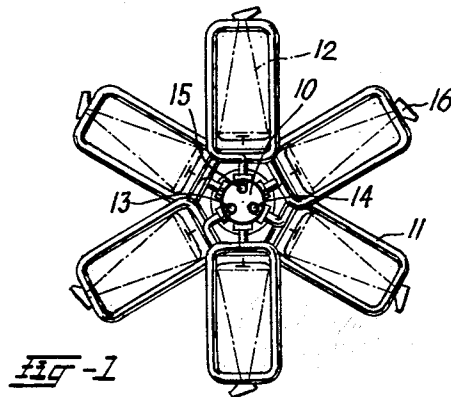
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3,130,080

CRYSTALLIZER FOR SUGAR AND THE LIKE

Filed March 8, 1961

2 Sheets-Sheet 1



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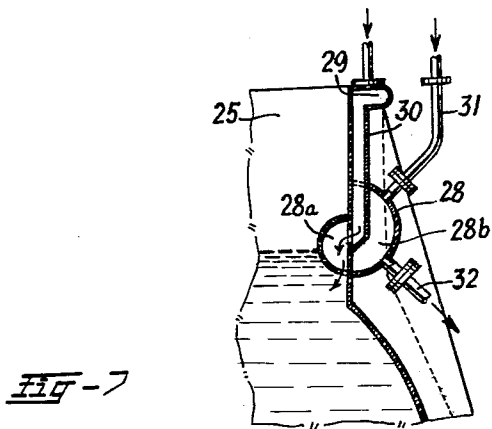
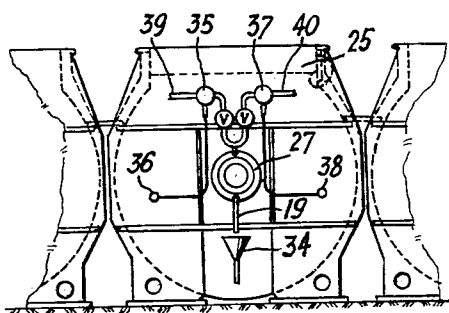
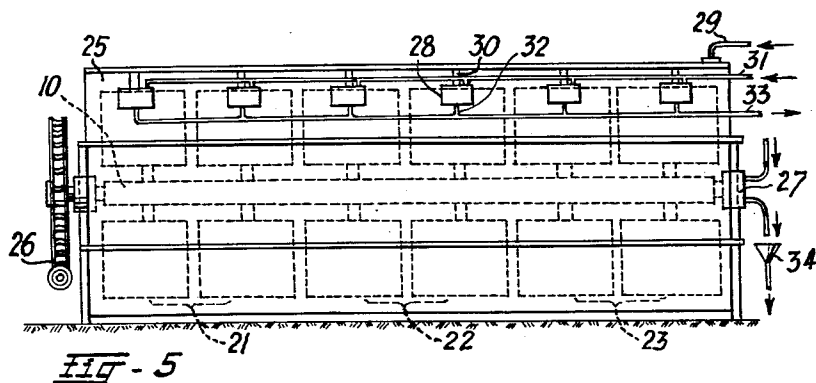
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CRYSTALLIZER FOR SUGAR AND THE LIKE

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2 Sheets-Sheet 2



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CRYSTALLIZER FOR SUGAR AND THE LIKE

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7 Claims. (Cl. 127-15)

This invention relates to a crystallizer for sugar and the like.

There exist many types of crystallizers to be used for sugar syrup and other crystallizing solutions in the chemical industry.

However, these known types have various disadvantages. Some of the prior types have a relatively small cooling surface, do not effect good mixing, produce no uniform movement of the raw material, and do not effectively remove crystals formed. Other prior types call for a cooling medium under pressure or constitute complicated constructions. Generally, the known types readily develop disturbances.

The primary object of my invention is to generally improve crystallizers for sugar and the like, and more particularly to provide a most effective, economically operating, and reliable crystallizing apparatus.

Other objects of the invention center about a crystallizer which will ensure perfect mixing of the material being treated, intensive heat transmission, uniform cooling and heating throughout the material, and the use of cooling and heating media under low pressure.

Still other objects of the invention will become apparent from the following description.

With the objects of the invention in view, I provide a crystallizer which comprises a vessel, a hollow shaft that is rotatable in the vessel about a horizontally extending axis, and means for rotating the shaft. The shaft defines an axial cavity. My crystallizer further includes a plurality of elongated tubular elements each of which has two terminal portions mounted on the shaft, a plurality of helical turns intermediate said terminal portions, whereby the helical turns project from the shaft in a common radial direction, a source of heat exchange medium, a plurality of elongated conduits, mounted within said shaft for joint rotation, distributing valve means, and conduit means. Each of the elongated conduits has a first and second end portion, each of the first end portions of the elongated conduits communicating with one of the terminal portions of a respective tubular element. The distributing valve means are freely mounted within the shaft, cooperate with the aforesaid conduits, and are interposed between the source of heat exchange medium and the referred to second end portions for sequentially and intermittently connecting the tubular elements to said source during rotation of the shaft. The conduit means communicate with the other terminal portions of the tubular elements for discharge of heat exchange medium from the tubular elements.

The invention and its advantages will be best understood from the following description of a preferred embodiment relating to the accompanying drawings which show a sugar crystallizer equipped with an agitator. In the drawings:

FIG. 1 is a sectional front elevation of the agitator;

FIG. 2 shows a detail of the agitator in side elevation;

FIG. 3 shows another detail of the agitator including the automatic distribution system for the cooling medium in a front elevational view on a scale larger than that of FIGS. 1 and 2;

FIG. 4 schematically illustrates the flow of cooling medium in the agitator;

FIG. 5 is a side elevational view of the crystallizer;

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FIG. 6 shows the crystallizer of FIG. 5 in front elevation; and

FIG. 7 is a detail view of the crystallizer in front elevation section.

Referring to the drawings in greater detail now, and initially to FIGS. 1 to 4, there is a hollow shaft 10 on which are mounted spirally shaped tubular elements 11. Each element consists of a plurality of helical turns disposed outside the shaft. Two oppositely arranged elements form a unit and a pair and are secured to the hollow shaft by a supporting frame 12. The elements 11 are shown in FIG. 1 to be mounted in form of a star system, with two adjacent elements forming an angle of 60°. Conduits 13, 14, 15 extend within, and parallel to the axis of the shaft 10 and supply, for instance, cooling liquid to six pairs of elements 11. FIG. 4 shows the cooling system of the apparatus of the present invention to be divided into three sections 21, 22, 23, each section consisting of two pairs of or four individual elements 11. It will be appreciated that my cooling system may be arranged in any other way. Each of the elements 11 and each of the sections 21, 22, 23 has two terminal portions. One of the terminal end portions of the sections 21, 22, 23 communicates with one of the longitudinally extending conduits 13, 14, 15, while the other terminal portion opens into the hollow space of the shaft 10, that is, the interior of the shaft outside the conduits 13, 14, 15. Each of the conduits 13, 14, 15 serves to conduct the cooling medium to one of the three sections 21, 22, 23. The conduit 13 feeds the section 21, the conduit 14 the section 22, and the conduit 15 the section 23. All of the three conduits communicate with a common admission chamber 24 within the hollow shaft 10. Each supporting frame 12 is provided on its boundary with pockets 16 (see FIG. 1) to collect and transport crystals of sugar and the like formed and dropped to the floor of a container holding the shaft 10 and the elements 11. The two terminal portions of each element enter the shaft and are fixed to the shaft with the aid of a flange 17 secured to the shaft (see FIG. 2).

In addition to the conduits 13, 14, 15, there is a discharge pipe 19 which extends centrally within the shaft 10 (see FIG. 3). An automatic distributor plate 18 which is freely slid upon the discharge pipe 19 has a center of gravity, that is downwardly spaced from the axis of the pipe 19, and is provided with three apertures 13, 14, 15 arranged so that each of these apertures may at any one time become aligned and may communicate with one of the conduits 13, 14, 15, as the latter rotate together with the shaft 10. From FIG. 3, it will also be seen that the conduits 13, 14, 15 as well as the three apertures in alignment with these conduits are arranged along a circle about the axis of the shaft 10 or pipe 19, or about the center of the plate 18. A fourth bean-shaped aperture 20 in the plate 18 is also provided along the same circular line.

Having now reference to FIG. 5 a substantially cylindrical vessel 25 referred to hereinbefore as container is horizontally arranged and encloses the shaft 10 and the cooling system 21, 22, 23. The shaft is supported in bearings 27 and receives its rotary motion over a worm gear 26. FIG. 5 shows clearly the division of the cooling system into three sections, and that each section consists of two pairs of elements 11. Each two opposite elements and two adjacent elements of the two pairs of a section are connected with each other, and one element of a section is connected with a conduit, while the another element of the same section is connected with the interior of the shaft. The cooling medium which is admitted to the chamber 24 (see FIG. 4) passes through a bearing 27, and continues, as has been pointed out hereinbefore,

at any one time through one of the conduits 13, 14, 15 to enter finally the respective cooling section.

Material to be treated is admitted through a supply pipe 29 which extends lengthwise within, and on top of, the vessel 25. From the pipe 29 branch as many pipes 30 off as there are pairs of elements 11. The pipes 30 open into chambers 28. The pipes 29, branches 30, and chambers 28 form a distribution system for the material to be treated. Steam may be supplied through a pipe 31 which enters all of the chambers 28. Condensate formed is led away through pipes 32 opening into a collecting pipe 33.

From FIG. 7 it will be seen that each of the chambers 28 has a rounded shape and consists of two compartments 28a and 28b, the former being an admission compartment for the material, and the latter being a steaming compartment. The supply pipe 29 and the respective branch 30 open into the compartment 28a, while the pipe 31 opens into the steaming compartment 28b.

FIG. 6 shows a device for automatically cooling the material to be treated. It is associated with a cold water line 39 and a hot water line 40. There is a valve 35 in the former, and a valve 37 in the latter. The valve 35 is provided with a sensing member 36, and the valve 37 with a sensing member 38. The discharge pipe 19 which, as has been stated, extends within, and coaxially with, the hollow shaft 10 is shown to empty into a funnel 34.

The operation of my crystallizer is as follows:

A crystallizing solution, for instance, sugar syrup, is shown in FIG. 7 to fill partly the vessel 25. The hollow shaft 10 rotates within the vessel, and along with the shaft rotate the conduits 13, 14, and 15 as well as the spirally shaped elements 11. A coolant is admitted to the chamber 24 from where it moves on to one of the conduits 13, 14, 15 and to one of the sections 21, 22, 23. The terms "coolant," "cooling liquid," and similar terms are used in this application to embrace a heating medium as well. The distribution of the coolant is effected by the device shown in FIG. 3. The plate 18 which is mounted on the discharge pipe 19 within the rotating hollow shaft does not participate in the rotation, which is due to the fact that the center of gravity is a distance below the common axis of the pipe 18 and shaft 10. As the conduits 13, 14, and 15 rotate, and whenever one of the conduits registers with the bean-shaped aperture 20, the registering conduit is free to communicate with the chamber 24. Such communication lasts as long as the registering of conduit and aperture 20 lasts. The respective section carries the coolant and communicates the cooling effect to the crystallizing solution, whereby at the same time, due to the rotation of the elements 11, the solution is mixed, and the cooling effect uniformly distributed.

With a crystallizing solution contained in the vessel 25, the sensing members 36 and 38 are in contact with the solution. The sensing member 36 opens the valve 35 and causes a cooling medium, cold water, to flow through the pipe 39 into the cooling system. Gradual cooling of the solution closes the valve 35. As soon as the temperature of the solution drops to a predetermined value, the supply of cooling water through the pipe 39 is automatically shut off, and the valve 37 is opened by an impulse of the sensing member 38. Thus, hot water is caused to flow through the pipe 40 into the cooling system.

It is believed that the construction and operation of a preferred form of apparatus for practicing the invention, and the many advantages thereof, will be fully understood from the foregoing detailed description. Some of the features and advantages of the invention are reviewed hereinafter. The cooling system is provided in form of individual spirally shaped elements. Two of such elements may form a pair, and a single pair or a number of pairs may be united to form a section. Individual elements or pairs of elements are arranged so that the cool-

ing medium flows separately through different parts of the system. The cooling medium is intermittently supplied to the various parts and to one part only at any one time. The principle of the supply of thermal energy according to the invention is most economical. The provision for supplying a fresh cooling or heating medium to separate parts of the system produces uniform thermal conditions throughout the entire mass of material that is treated. The continuous movement of the tubular system produces intensive heat transmission and allows, for instance, a reduction of the cooling area as far down as 0.7 m.²/t. of sugar syrup. The liquid cooling or heating medium is used under low pressure. It flows into the tubular system by gravity and proceeds, due to the rotation of the system, in forced circulation. In fact, the system of the invention acts as a pump. Mixing of the material takes continuously place in the entire vessel and is very intensive. Grown crystals are easily collected. Any overgrowing of the chambers 28, for instance, with sugar crystals can be prevented by periodic steaming of the chambers. Added crystallizing solution is uniformly distributed in the entire mass in the vessel of the apparatus so that increasing resistance of the mass as it grows denser to the rotation of the cooling system, and the time required for the crystallization of the added material, is reduced to a minimum.

It will be apparent that while I have shown and described my invention in a preferred form, many changes and modifications may be made without departing from the spirit of the invention defined in the appended claims.

What I claim is:

1. A crystallizer for sugar and the like, comprising, in combination:

- (a) a vessel;
- (b) a hollow shaft rotatable in said vessel about a horizontally extending axis and defining an axial cavity;
- (c) means for rotating said shaft about said axis;
- (d) a plurality of elongated tubular elements, each of said elements having two terminal portions mounted on said shaft, and a plurality of helical turns intermediate said portions, said helical turns projecting from said shaft in a common radial direction;
- (e) a source of heat exchange medium;
- (f) a plurality of elongated conduits mounted within said shaft for joint rotation, each of said elongated conduits having a first and a second end portion, each of said first end portions communicating with one of the terminal portions of a respective tubular element;
- (g) distributing valve means freely mounted within said shaft and interposed between said source and said second end portions for cooperation with said elongated conduit and sequentially and intermittently connecting said tubular elements to said source during rotation of said shaft; and
- (h) conduit means communicating with the other terminal portions of said tubular elements for discharge of heat exchange medium from said elements.

2. A crystallizer as set forth in claim 1, wherein said valve means includes distributor plate means, said plate means having a center of gravity downwardly spaced from said axis, and being formed with apertures, said second end portions of said elongated conduits having orifices alignable with said apertures for selective passage of liquid therebetween when said elongated conduits rotate about said axis.

3. A crystallizer as set forth in claim 1, wherein said other terminal portions of said elements directly communicate with said cavity, and said conduit means include a discharge pipe coaxial with said shaft and communicating with said cavity, said plate means being mounted on said discharge pipe.

4. A crystallizer as set forth in claim 1, wherein said other terminal portions of said elements directly com-

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municate with said cavity, and said conduit means include a discharge pipe communicating with said cavity.

5. A crystallizer as set forth in claim 1, wherein said plurality of tubular elements includes a plurality of pairs of tubular elements, the elements of each pair having respective helical turns projecting from a common axial portion of said shaft in opposite radial directions and in a common axial plane, the common axial planes of said pairs being angularly offset about said axis.

6. A crystallizer as set forth in claim 1, wherein the helical turns of each of said tubular elements have a common axis of symmetry substantially parallel to the axis of rotation of said shaft and radially spaced therefrom.

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7. A crystallizer as set forth in claim 1, wherein each of said tubular elements includes a flange portion secured to said shaft and connecting said two terminal portions thereof and secured to said shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

2,458,440	Stafford	Jan. 4, 1949
2,594,142	Feldstein et al.	Apr. 22, 1952
2,650,175	Rodriguez	Aug. 25, 1953

FOREIGN PATENTS

598,052	Great Britain	Feb. 10, 1948
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