The present invention relates to a number of improvements made in the rotary tubular crystallizers and rotary crystallizer-cookers described in U.S. Patents No. 1,684,601 of November 15, 1927, No. 1,683,712 of December 27, 1927 and No. 1,815,852 of July 21, 1931.

The improvements which are the object of the present invention are as follows:

1. Instead of being arranged in spiral or other like curves, the tubes of the bank are arranged in radial lines forming a number of groups, each comprising a plurality of tubes, said radial groups being connected two by two, four by four, or eight by eight, for forming eight, four or two banks of 16 tubes of even number, this being done in such a manner that both the inlet orifice and the outlet orifice of each of the aforesaid banks are located at the same end of the drum.

2. The connections between the tubes of the same plane or from one plane to another are effected by means of pipes which are welded on the tubes in question, without a joint of any kind.

3. The apparatus is so arranged that the circulation of the water or of the steam is effected by starting from the central tube of one of the groups and the water or the steam in question flows in a zig-zag path through all the tubes of the plane, then through one of the connecting pipes opening into the groups of tubes of the adjacent plane, flows in a zig-zag course through the group in question and returns, after having thus flowed through an even number of plane groups, toward the end of the drum whence it started.

4. The filling and emptying doors of the apparatus are placed in the spaces which separate two groups of tubes.

5. All the tubes of the apparatus pass through a single end plate of the drum and are welded on said plate so that they are integral with same, thereby being no tubes on the end plate which is located at the other end of the drum.

6. The tubes pass with a running fit in the orifices provided therefor in the arms of the radial supporting stays arranged in the drum.

7. In order to facilitate the removal and the replacing of the tubes of the apparatus, without danger of damaging the end plate, this latter is secured, for each tube, to a bushing having a slightly larger diameter than the outside diameter of the tube itself, which bushing is welded externally on the end plate in question, the tube being welded to the bushing in question.

8. In order to protect the tubes of the bank from wear which is liable to occur in the long run at the points of contact of said tubes on said supporting stays, bushings made of a metal which is preferably softer than that of the tubes are fixed on said supporting stays, said bushings having a slightly larger internal diameter than the tubes which pass through them and substantially increasing the area of contact between the tube and its support.

9. In a modification, each of the tubes carries reinforcing rings at the points of contact with the supporting stays.

10. The means specified in 8 and 9 may be combined with a means which enables the points of contact of each tube with its supporting stays to be varied, said means consisting in Interposing thicknesses at the spot where the end plate carrying the tubes is connected to the body of the drum.

11. Opposite each of the tubes of the bank is located a threaded plug which enables an appropriate device to be introduced into the corresponding tube, for removing scale or for cleaning the inside of the tube in question.

12. The valve provided at the centre of the end plate in which there are no tubes, through which valve the material to be treated is introduced into the apparatus, comprises a plurality of additional inlets each connected to an injection tube, these various tubes being arranged concentrically relatively to each other and opening at various arbitrarily chosen points on the length of the drum, which arrangement furthermore permits of a more homogeneous treatment of the mass.

13. The drum is driven through the intermediary of a speed varying device which enables the effects of the crystallization to be varied and the power necessary for driving the drum to be varied.

In the accompanying drawings, an embodiment of the apparatus provided with the improvements which are the objects of the present invention, has been shown diagrammatically and by way of a non-limitative example.

In said drawings:

Fig. 1 is a longitudinal view in partial vertical section, of the rotary tubular crystallizer;

Fig. 2 is an end view of same;

Fig. 3 shows a detail on a larger scale;

Fig. 4 is a modification of Fig. 3.

As can be seen in the accompanying drawings, the tubes I of the bank of tubes of the apparatus, instead of being arranged in spiral or like curves (as is the case in the apparatus described in the aforementioned U.S. patents), are arranged in radial planes; in the example shown in the draw-
ings, the tubes are distributed in sixteen radial groups having eight tubes each, said radial groups being connected two by two, four by four, or eight by eight, for forming eight, four, or two bands of tubules of even number, this being done in such a manner that both the inlet orifice and the outlet orifice of each of the banks are located at the same end of the drum T.

The connections between the tubes 1 of the same plane or between the tubes of two adjacent planes, are effected by means of bent tubes 2 welded on the tubes 1 themselves, so that it is possible to avoid using any joints that are liable to cause leaks, either inside, or outside the apparatus.

The circulation of the water or of the steam is effected in such a manner that the aforesaid water or the steam starts from the central tube of one of the groups and successively flows:

- In a zig-zag path through all the tubes of the same plane; through one of the pipes 2 extending from the last tube of the plane in question to each of the group of tubes of the adjacent plane; in a zig-zag path through the group of tubes of the plane in question, and so forth, the aforesaid water or steam finally returning towards the end of the apparatus where the inlet is located.

The above arrangement ensures “the thermal uniformity”, the principle of which was explained in the aforesaid U. S. Patent No. 1,683,712.

All the inlet tubes are connected to a radial distributor 3 and all the outlet tubes are connected to a similar radial distributor 4. The filling and emptying doors 5 are placed in the space which separates two adjacent groups of tubes; the arrangement of which in radial planes enables the cooled masses to flow more easily.

At one of the ends of the drum T, the tubes pass through the end plate 6 to which they are connected in such a manner that they are integral with the same, there being no tubes on the end plate 7 which is located at the other end of the drum. Owing to this arrangement, the tubes of the bank can expand and contract freely; the drum can be readily inspected since it suffices to unbolt the end plate 7 in order to have free access to the inside of the drum, and it is furthermore possible to move the entire bank of tubes as a unit with the end plate 6, after loosening the bolts provided for assembling said plate with the body of the drum T.

In order to facilitate the removal and the replacing of the tubes 1 without danger of damaging the end plate 6, as would invariably occur if the tubes in question were welded directly on said plate, a bushing 8 has been provided for each tube, which bushing is of slightly greater diameter than the outside diameter of the tube in question, the base of said bushing being welded on the end plate 6, the tube 1 being in its turn welded on its corresponding bushing. In order to withdraw the tube thus mounted, it suffices to saw a small piece of the bushing without touching the end plate. When the repaired tube or the new tube has been inserted, it suffices to weld same on the bushing.

In order to enable the tubes of the bank to expand freely in the drum, they are mounted with a running fit in holes provided therefor in the arms of the radial supporting stays 9. Said supporting stays were formed, in the known apparatus, by cut out or perforated plates or by channel irons assembled in radial formation and perforated. Now, owing to the play which exists between each of the tubes and the edges of the hole provided in the support, owing to the movement of the crankshaft due to the rotation of the apparatus, slight, four or the finally owing to the longitudinal expansions and contractions, the friction thus produced eventually perforates the tubes, thereby causing leaks.

According to the present invention, the tubes of the bank are protected from the wear referred to above by the following means: on the supporting stays are mounted bushings 10 (see Fig. 3) in each of which a tube 1 of the bank of tubes can slide with a running fit, the bushings in question (which are preferably made of a softer metal than the tubes) substantially increasing the area of contact between the tubes and their respective support.

In a modification shown in Fig. 4, a reinforcing ring 11 has been welded on each tube 1 at the spot where it comes into contact with the supporting stay 9. The two above specified means may of course be combined with each other. They may furthermore be combined with a means which enables the point of contact of the tubes 1 with the supporting stay to be varied. Said means consists in interposing, at the joint of the end plate 6 with the body of the drum T, thick asbestos 12 which may be sawed into pieces, in order to shift the whole of the bank of tubes, either forwards, or backwards, so as to change the surfaces which are subjected to the friction.

Opposite each of the tubes 1 of the bank is located a threaded plug 13 or any other similar closure device which enables either a metal bush, or any other equivalent means to be introduced into the tube in question for removing scale or cleaning the inside of same.

The valve 14 which is mounted at the centre of the end plate 7 by means of a stuffing box 15, enables the cooked mass to be introduced into the apparatus when stationary or when in rotation. In the above mentioned U. S. Patent No. 1,813,562, the applicant had provided for the use of a tube passing through said valve for injecting liquid medium to the drum in such a way as to shift the whole of the bank of tubes, either forwards, or backwards, so as to change the surfaces which are subjected to the friction.

The valve 14 comprises a plurality of additional valves 15, 16, 17 (or more) which respectively control concentric tubes 18, 19 (or more) opening at various points 20, 21, 22 distributed over the length of the drum T, thereby producing a more homogeneous treatment of the mass.

Finally, the drum T is driven through the intermediary of a speed varying device 23 which enables the speed of rotation of the drum to be varied at will, this having the dual advantage of enabling variations to be made in the crystallizing effects and of enabling the power required for driving the apparatus to be varied. Thus, for example, the speed of rotation of the drum may be decreased when the cooked mass becomes very thick.

It is obvious that the exemplary embodiment of the rotary tubular crystallizer described herein and illustrated in the accompanying drawings is only given in an indicative and non-limitative manner and that modifications may be made in the improved apparatus according to the present invention, without departing from the spirit of the invention.

What I claim is:

1. A crystallizer comprising a rotatable closed cylindrical casing, a plurality of tubular elements arranged in radial groups, the tubes of said ra
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2. In a crystallizer as claimed in claim 1 the combination of an end plate, a plurality of tubes, the said plate being secured, for each tube, to a bushing of slightly larger diameter than the outside diameter of the tube itself, said bushing being welded on the outside of said end plate and the tube being welded to the bushing.

3. In a crystallizer as claimed in claim 1 an inlet valve for the material to be treated, the said valve being provided at the centre of the end plate on which there are no tubes, and a plurality of additional inlets each connected to an injection tube, said tubes being arranged concentrically with respect to each other and opening at various arbitrarily chosen points along the length of the cylindrical casing of the crystallizer, whereby the treatment of the mass may be made more homogeneous.

4. In a crystallizer as set forth in claim 1 means for varying the points of contact of each tube with its support, said means comprising an end plate for said casing, spacing elements interposed between said end plate and said casing so that by varying the number of said spacing elements a relative displacement is secured between said end plate and each tube.

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