

Oct. 27, 1953

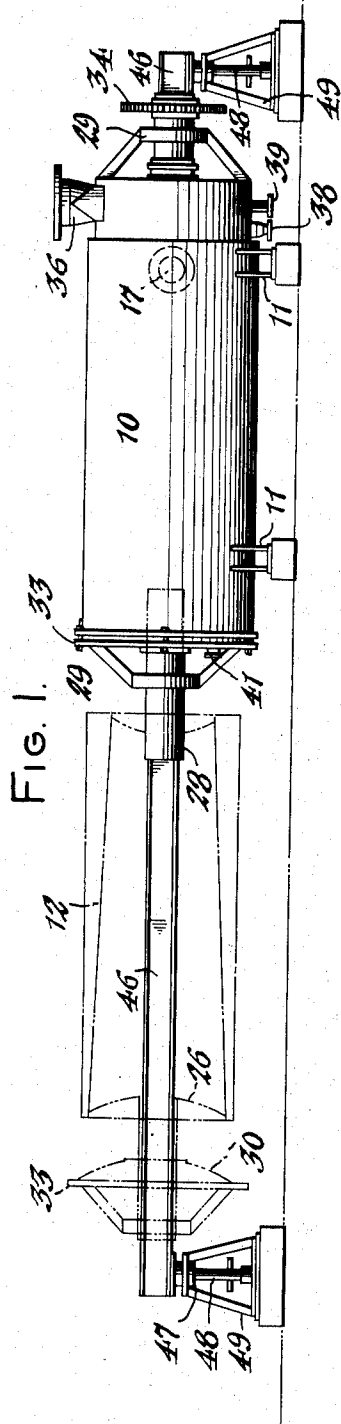
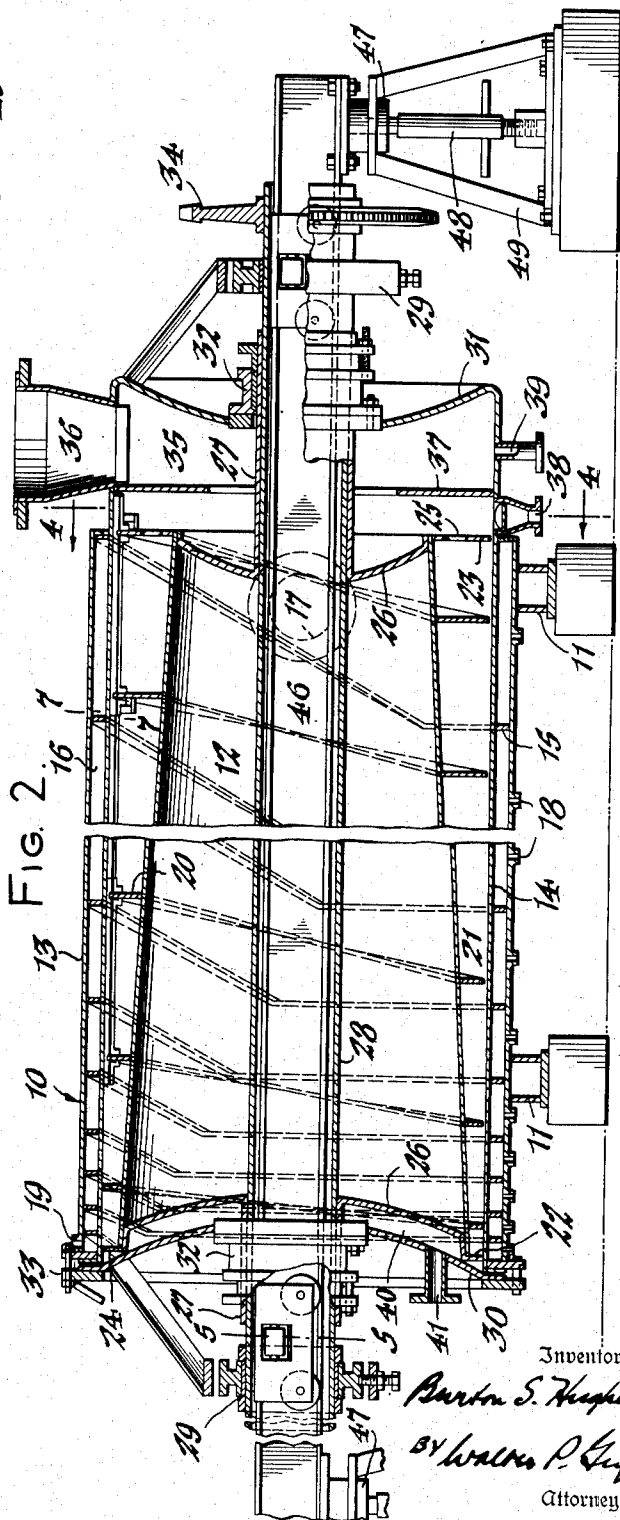
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2,656,885

CONCENTRATING APPARATUS

Filed Feb. 16, 1949

2 Sheets-Sheet 1



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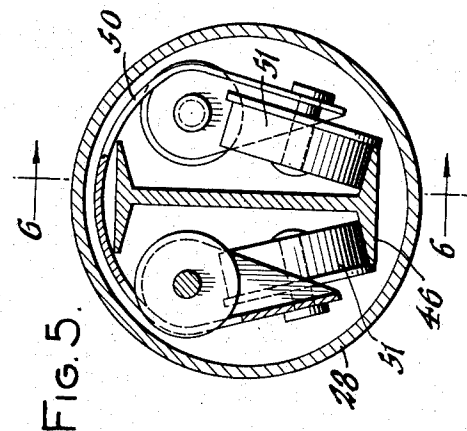


FIG. 5.

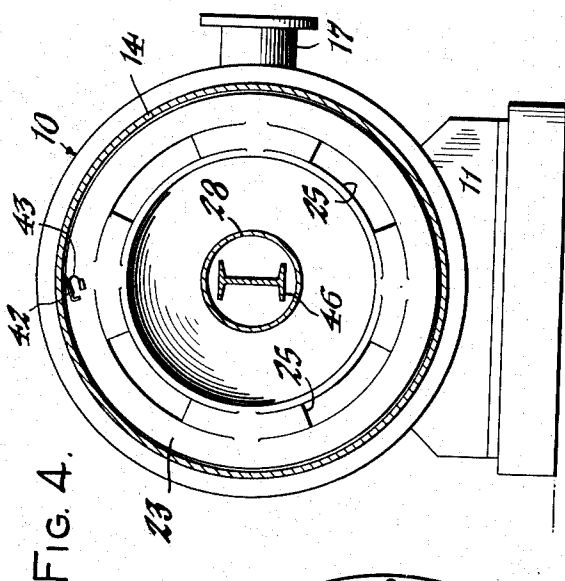


FIG. 4.

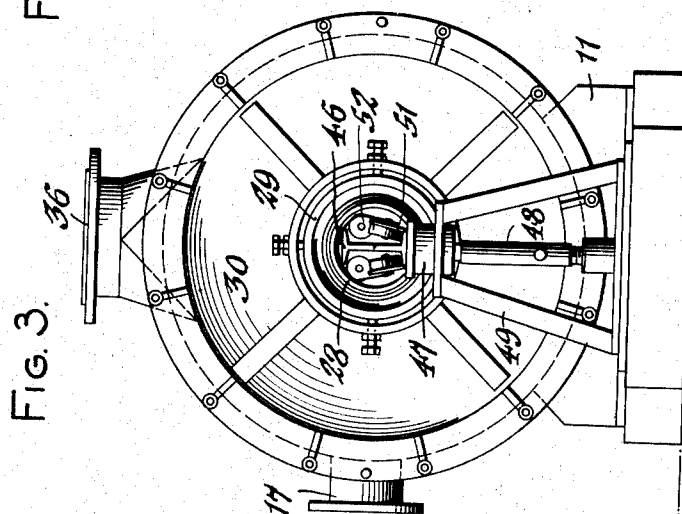


FIG. 3.

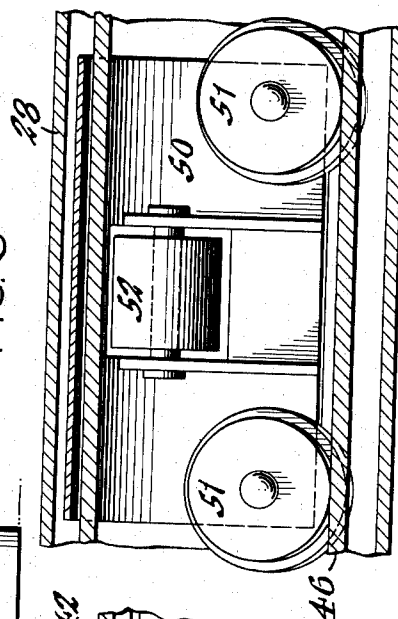


FIG. 6.

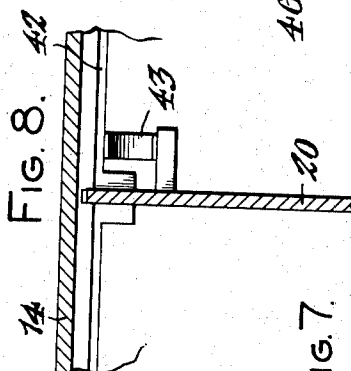


FIG. 8.

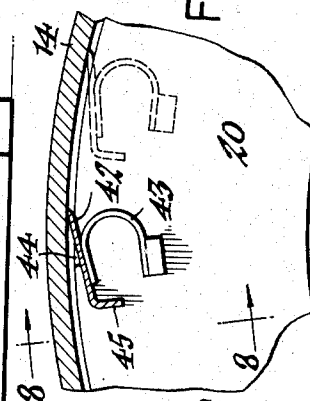


FIG. 7.

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UNITED STATES PATENT OFFICE

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CONCENTRATING APPARATUS

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4 Claims. (Cl. 159—11)

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This invention relates generally to certain new and useful improvements in concentrators, but more particularly to a concentrating apparatus for evaporating water from fruit juices and like solutions which cause the coating of the heating surfaces with a slimy or gelatinous layer and interfere with the heat transfer unless continuously removed.

It is one of the objects of this invention to provide a concentrator of this character which is so designed and constructed as to provide for a high velocity of steam and vapor therethrough with a high rate of heat transfer and with less heating surface required for a given amount of evaporation.

Another object is to provide a concentrating apparatus which will effect concentration of the material in one pass therethrough and thereby prevent loss of valuable properties, particularly in sensitive materials, due to the short time the material is in contact with the heating surfaces.

A further object of the invention is to provide a concentrator whose interior parts are so designed and arranged as to enable their ready withdrawal for cleaning.

Other features of the invention reside in the construction and arrangement of parts herein-after described and particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is a side elevation of the concentrating apparatus embodying my invention. Figure 2 is an enlarged fragmentary central longitudinal section thereof. Figure 3 is an end view of the same, viewing the left hand end of Figure 1. Figures 4 and 5 are cross sections taken substantially on the correspondingly numbered lines in Figure 2. Figure 6 is a longitudinal section taken on line 6—6, Figure 5. Figure 7 is an enlarged fragmentary cross section taken on line 7—7, Figure 2, showing one of the scrapers for cleaning the inside surface of the steam jacket cylinder. Figure 8 is a fragmentary longitudinal section taken on line 8—8, Figure 7.

Similar characters of reference indicate corresponding parts throughout the several views.

In the preferred embodiment of the invention shown in the drawings, it comprises an outer stationary heating unit or steam jacketed cylinder 10 supported on suitable pedestals 11, 11, and an inner, slowly rotating cylinder 12 of substantially frusto-conical shape disposed therein and between the annular surfaces of which cylinders the liquid to be concentrated is introduced and passed.

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The steam jacketed cylinder 10 consists of an outer shell 13 and a concentrically-spaced inner shell 14 having helically-disposed ribs 15 therebetween providing a helical or spiral passage 16, closed at its ends, for the circulation of the steam which is introduced thereto through an inlet 17 located adjacent one end of such cylinder. This helical steam passage is gradually decreased in cross-sectional area from its intake end in such proportion as to maintain a fairly uniform velocity of the steam. In its outer shell 13 this cylinder has a plurality of condensate drains 18, and in its top it has a vent 19 for non-condensibles.

The inner rotatable cylinder 12 is tapered from the vent end of the stationary cylinder to its steam intake end and provided on its outer surface are helices or spiral ribs 20 which form a helical or spiral passage 21 for vapor between this rotating cylinder and the inner shell 14 of the companion cylinder. The ends of this passage are closed by walls 22, 23 and the wall 22 has a plurality of small intake ports 24 therein for the liquid to be concentrated while the opposite wall 23 has a plurality of larger outlet ports 25 therein. The ends of the rotating cylinder are closed by dished heads 26 having collars 27 thereon and these collars are attached to a hollow shaft 28 extending axially through the cylinder and supported at its ends in suitable adjustable bearings 29 attached to heads 30, 31 applied to the extended end portions of the stationary cylinder 10 and having stuffing boxes 32 disposed between the shaft and such heads. The head 30 is detachably connected to an end closure flange 33 applied to the corresponding end of the cylinder 10 while the companion head 31 may be fixed by welding or the like. A drive sprocket 34 is fixed on one end of this shaft for connection to a suitable source of power to impart a slow rotation to the inner cylinder 12.

The inner shell 14 of the stationary or steam-jacketed cylinder 10 is extended at one end beyond the tapered end of the rotating cylinder 12 to provide a vapor chamber 35 having a discharge passage 36 adapted for connection to a condenser. This chamber has a transverse partition or annular member 37 substantially centrally thereof to divide it into two parts and to prevent any of the concentrate discharged from the spiral passage 21 being carried out by the vapor. At the inner side of this partition the extended portion of this cylinder has a discharge opening 38 for the concentrate and at the opposite or outer side thereof it has a

drain 39 for removing the water while washing the interior of the apparatus. Between the opposing heads 26 and 30 there is provided a chamber 40 into which the liquid to be concentrated is introduced through an inlet 41 5 formed in the head 30 and from which chamber the liquid is discharged through the ports 24 into the spiral passage 21 between the companion cylinders 10 and 12.

Disposed between and mounted on each pair 10 of helices 20 is a scraping blade 42 in contact with the inner surface of the shell 14 of the steam jacket cylinder 10 to keep such surface clean of foreign matter during the rotation of the cylinder 12 and maintain the heat transfer 15 into the spiral passage 21 at a maximum at all times. A light, substantially U-shaped spring 43 adjacent each end of the blade maintains it against the inner shell-surface, and the ends of the blade fit into a shallow notch 44 provided 20 in the edges of adjoining helices with a milled slot 45 into which the edge of the scraper is inserted for holding it in place.

Extending through and beyond either end of the hollow shaft 23 is a beam 46, which may be 25 of I-beam cross section, as shown in Figure 5, and which is supported at its opposite ends on vertically-adjustable pads 47 applied to companion jack-screws 48 mounted on frames 49. Trolleys 50 are arranged adjacent the ends of 30 this hollow shaft, each including four wheels 51 in rolling contact with the base-flanges of the beam and two rollers 52 having their axes parallel with the axis of the shaft and adapted for contact with the inside of such shaft when the 35 beam 46 is elevated. In the normal position of the parts shown in the drawings, with the beam lowered, the rollers 52 are free from contact with the hollow shaft 23 and it can turn freely. However, when the beam is raised by the jack-screws 48, these rollers contact the inner surface of the 40 shaft and the inner assembly 12 of the concentrator and its associated parts can be removed from the outer assembly 10 for cleaning, as shown by dot-dash lines in Figure 1. The inner assembly can be rotated on the trolley-rollers 52 for 45 convenience in washing and scrubbing the parts.

This apparatus is particularly useful in the evaporation of such products as fruit juices and the like which coat the heating surfaces with a slimy or gelatinous-like layer, and due to its structural arrangement of parts and the high velocity of the steam and the vapor, the rates of heat transfer are high and a minimum of heating surface is required for a given amount of 50 evaporation, all of which makes possible the concentration of the juice or solution in one pass through the concentrator without loss of valuable properties because of the short time it is in contact with the heating surfaces.

This apparatus, because of the ready removability of its interior parts for thorough cleaning, is also adaptable for evaporating water from milk or other solutions which must be concentrated under completely sanitary conditions. For 55 such use the inner cylinder 12 can be stationary and need not be revolved.

I claim as my invention:

1. An apparatus of the character described, comprising an outer steam jacketed cylinder including helices therein to define a spiral-like passage for the steam and having end heads containing axial bearings, an inner tapered rotatable cylinder disposed axially of and in spaced relation to said outer cylinder for removal therefrom 70

and to provide a forwardly-diverging annular passage adapted for communication at its converging intake end with the solution to be concentrated, said inner cylinder having helices on the exterior thereof extending through said annular passage from end to end thereof, and a hollow shaft extending axially of the inner cylinder and journaled at its ends in the head bearings of the outer cylinder and constituting a support 5 for said cylinders, the outer cylinder having a chambered portion extending beyond the converging end of the inner cylinder and in communication with the diverging end of said passage and having a vapor outlet and a concentrate discharge therein, and an annular transverse partition in said chamber separating said discharge from said vapor outlet.

2. An apparatus of the character described, comprising an outer cylinder having end heads one of which is removable, bearings applied axially of said heads, an inner revolvable cylinder disposed axially of and in spaced relation to said 10 outer cylinder for removal therefrom, a hollow shaft extending axially of said inner cylinder and journaled at its end in the outer cylinder bearings, a beam extending through said shaft and adapted to be supported beyond the ends of the same, and trolley devices in said shaft including wheels in longitudinal guiding contact 15 with said beam and rollers for contact with the inner surface of said shaft.

3. An apparatus of the character described, comprising an outer cylinder having end heads provided with bearings, one of said heads being 20 removably mounted on such cylinder, a revolving cylinder removably arranged within said outer cylinder and including a hollow shaft extending at its ends through said end heads and journaled in the bearings thereof, a beam extending freely through said hollow shaft, vertically-adjustable supports for the ends of said beam, and trolley means disposed between the beam and the interior of said shaft and having wheels thereon for 25 rolling contact with said beam and rollers normally out of contact with said shaft but adapted to contact the inner wall thereof in an elevated position of the beam when removing the revolving cylinder from the outer cylinder.

4. A concentrating apparatus, comprising a 30 horizontally-disposed cylindrical heating unit including inner and outer spaced shells having means in the annular space therebetween for circulating a heating medium therethrough in a helical path with the cross-sectional area of such path decreasing from one end thereof to the other to maintain a substantially uniform velocity of 35 the heating medium, the outer shell having a plurality of openings therein for the continuous removal of the condensed heating medium, a cylinder of substantially frusto-conical shape, and closed at its ends, disposed axially within 40 said heating unit in spaced relation thereto and having helices on its exterior surface defining a helical passage for the vaporizing of the solution to be concentrated, the helical passage being closed at its ends and having intake ports at one end for the liquid to be concentrated and outlet 45 ports at its opposite end and the cross sectional area of such passage increasing from its intake to its discharge end, the inner shell of said heating unit extending beyond the reduced end of the frusto-conical cylinder to provide a communicating vapor chamber having a concentrate discharge in its lower side and a vapor discharge in 50 its upper side, and an annular partition disposed 55

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in said vapor chamber in a plane between the concentrate and vapor discharges to prevent the concentrated material being carried out by the vapor.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
942,407	Ordway -----	Dec. 7, 1909
1,164,413	Shaw -----	Dec. 14, 1915
1,355,702	Shaw -----	Oct. 12, 1920

Number
1,415,255
1,576,838
1,580,164
1,730,902
1,854,619
2,032,785

6

Name	Date
Miller -----	May 9, 1922
Mellott -----	Mar. 16, 1926
Pezold -----	Apr. 13, 1926
Rugh -----	Oct. 8, 1929
Mortensen -----	Apr. 19, 1932
Zorn et al. -----	Mar. 6, 1936

FOREIGN PATENTS

Country	Date
Great Britain -----	Feb. 5, 1894
Norway -----	May 28, 1906