Feb. 20, 1951 G. G. ZAHM 2,542,270

SCRAPER APPARATUS FOR CENTRIFUGAL EVAPORATORS

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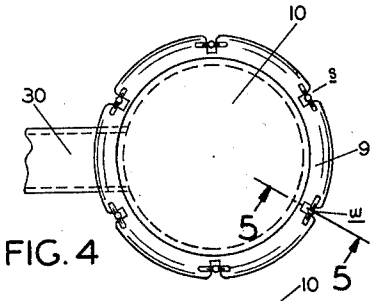

FIG. 4

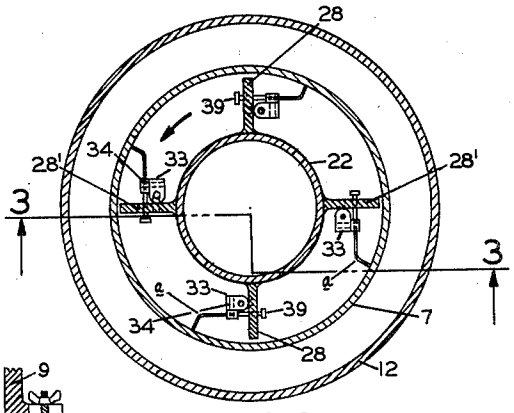

FIG. 2

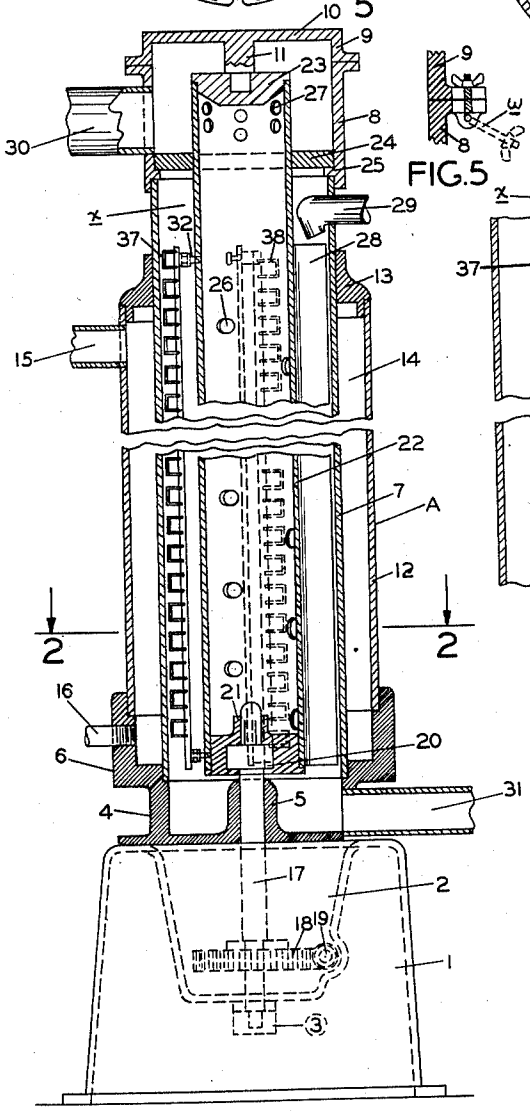

FIG. 1

FIG. 5

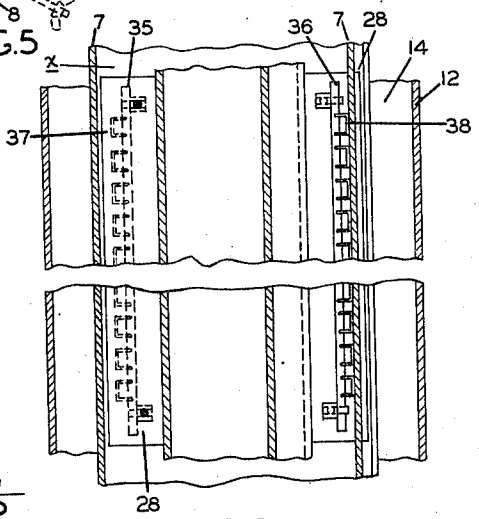

FIG. 3

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SCRAPER APPARATUS FOR CENTRIFUGAL EVAPORATORS

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3 Claims. (Cl. 159—6)

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This invention relates to certain new and useful improvements in apparatus for concentrating liquids and, more particularly, liquids containing organic substances which would be impaired if the liquid were subjected to a high temperature for a considerable period of time.

It is the primary object of this invention to provide apparatus for treating organic solutions and colloidal liquids, whereby the liquid content in the same may be reduced quickly and economically and without impairing the chemical constituency, taste, or quality of the solutions or liquids.

It is a further object of the present invention to provide apparatus of the type and for the purpose stated in which entrainment is substantially eliminated.

It is a further object of this invention to provide means for causing liquids of the type stated to travel over a heat exchange surface under vacuum at high velocity, in a relatively thin film, and without building up a static coating on the heat exchange surface.

The above and other objects will become more fully apparent from the following specification, which, by way of illustration rather than limitation, sets forth preferred processes and preferred forms of apparatus constituting embodiments of the present invention, the scope of which is defined in the appended claims.

In the accompanying drawing:

Figure 1 is a fragmentary vertical sectional view of a preferred form of apparatus for practicing my invention;

Figure 2 is a horizontal sectional view taken along line 2—2 of Figure 1;

Figure 3 is a fragmentary sectional view taken along line 3—3 of Figure 2;

Figure 4 is a top plan view of the apparatus; and

Figure 5 is a sectional view taken along line 5—5 of Figure 4.

In its general organization, A designates a preferred form of apparatus comprising a preferably cast iron base housing 1 having a centrally depressed gear box 2 provided in its bottom wall with a step-bearing 3. Welded or otherwise secured upon the upper face of the housing 1, in closure-forming disposition across the top of the gear box 2, is an upstanding base ring 4 having a vertical shaft-bearing 5 axially aligned with the step-bearing 3, and around its upper peripheral margin the base ring 4 is integrally provided with a diametrally enlarged upwardly extending collar 6. Shrunk or otherwise suitably secured

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in the base ring 4 and extending upwardly therefrom in concentric relation to the shaft-bearing 5 is a cylindrical column 7, preferably constructed of copper, stainless steel, or other suitable material having a high co-efficient of heat conductivity, and provided at its upper end with a peripherally flanged head ring 8 having a plurality of uniformly spaced swingable wing bolts *w* for retentive engagement in complementarily located peripheral slots *s* formed in a removable cap or dome 9 preferably of cylindrical form and including a horizontal top wall 10, which is, in turn, provided with a depending pintle or bearing-stud 11 aligned axially with the shaft-bearing 5.

Surrounding the column 7 and fixed at its lower end in the collar 6 is a cylindrical jacket or shell 12, and at its upper end the shell 12 is secured in a closure-collar 13 mounted around the column 7 somewhat below the head ring 8, thus forming an intervening jacket space 14 which is adapted to receive steam or other heating medium for heating the column 7. The steam or other heating agent is preferably supplied to this jacket space 14 by means of a steam supply pipe 15 fixed in and extending through the shell 12 adjacent its upper end, the excess steam and water of condensation being withdrawn from the lower end of the jacket space 14 by a discharge pipe 16 threaded through the collar 6.

Rotatably mounted at its lower end in the step-bearing 3, and projecting upwardly through the bearing 5, is a vertical shaft 17 provided along the portion of its length within the gear box 2 with suitable driving gears 18, 19, which are conventionally connected to a prime-mover (not shown). At its upper end, the shaft 17 is connected by means of a spline collar 20 to a head 21 rigidly mounted in the lower end of a cylindrical impeller tube 22 of substantially smaller diametrical size than the column 7 and extending co-axially upwardly therethrough into the dome 9. At its upper end, the tube 22 is provided with an end plate 23, which rotatably engages the bearing stud 11, and projecting inwardly at the lower end of the ring 8 is an annular horizontal partition plate 24 centrally bored and provided with a packing ring 25 for gland-wise engaging the tube 22. Within the column 7, the tube 22 is provided with four equally spaced vertical lines of apertures 26, and above the partition plate 24, the tube 22 is further provided with a plurality of circumferentially spaced apertures 27, so that the dome 9 communicates directly with the interior of the tube

22, but does not communicate directly with the annular vapor space between the outer face of the tube 22 and the inner face of the column 7.

Welded to the outer face of the impeller tube 22 just ahead of each vertical line of apertures 26 (reference being had to the direction of rotation of the impeller tube 22 as shown by the inner arrow in Figure 2) are pairs of diametrally opposed impeller blades 28, 28', terminating in almost tangential relation to the inner face of the column 7, but having a slight amount of clearance. The impeller blades 28 are somewhat shorter in vertical length than the column 7 so as to provide a head space x. Beneath the partition plate 24 and projecting through the column 7 into this head space x is a supply-line 29 bent over at its inner end so as to discharge the stream of the incoming liquid against the inner face of the column 7. Finally, the column 7 is provided with a vacuum line 30, which extends through the head ring 8, and a discharge line 31, which extends through the base ring 4, the lines 30 and 31 being connected, respectively, to conventional high vacuum pumping equipment and liquid storage or packaging equipment (not shown).

Extending from the rear side of each of said blades 28 (reference being had to the direction of rotation as shown by the arrows in Figure 2) is a plurality of vertically aligned ears 32 each provided for rockably supporting a pivot block 33 held thereon by means of a pintle 34 mounted upon the ear 32.

Secured rigidly to the outwardly presented faces of the pivot block 33 are vertically extending rods 35, 36, fabricated preferably of stainless steel, said rods 35, 36, being the same length as the impeller blades 28, 28'. Mounted on, and extending rearwardly from, the rod 35 is a plurality of wire-loop scrapers 37, said scrapers 37 being bent outwardly at their outer end, as at a, and similarly mounted on, and extending rearwardly from, the rod 36 are wire-loop scrapers 38. The scrapers 37 on the rods 35 are horizontally located in line with the spaces between the scrapers 38 on the rods 36, so that liquid material which flows between the scrapers 37 will be picked up by the scrapers 38. Upon rotation of the impeller blades, centrifugal action causes the pivot blocks 33 to swing, whereby the wire-loop scrapers 37, 38, are swung outwardly into contact with the inner walls of the column 7. By said scraping action, the film of liquid which has accumulated upon said walls is merely raised and lifted over the loop portion of the wire-loop scrapers 37, 38. By this action, the film which has accumulated upon the walls of the column 7 is kept under a state of movement and film is thereby not permitted to solidify on said walls in the formation of a crust which would materially decrease the passage of heat through said walls of the column 7 from the jacket 14.

Threadedly secured and extending through the impeller blades 28, 28', outwardly adjacent from the lugs 32, are set screws 39. The threaded end of said screws 39 is aligned with the forward surface of the rods 35, 36, so that they will abut against said surfaces when they move forwardly as the pivot blocks 33 swing forwardly under centrifugal force.

In operation, a stream of liquid is admitted through the supply pipe 29 and permitted to flow down by gravity on the inner face of the column 7 while the latter is externally heated by admission of steam through the jacket space 14. As the liquid flows downwardly, a centrifugal motion is imparted to it by the impeller blades 28 in the formation of a thin tubular film against the inner face of the column 7.

During its flow from the supply line to the discharge line 31, the stream of liquid is subjected to high vacuum and a substantial portion will pass off as vapors through the apertures 26, as diagrammatically indicated by the outer arrows in Figure 2, the vapor flowing upwardly through the tube 22 and the apertures 27 into the dome 9 and thence into the vacuum line 30. The clearance between the outer edges of the blades 28 and the walls of the column 7 permit portions of the liquid to escape from the influence of the blades and form a thin film extending from the rear side of each blade to the front of the next following blade 28. The liquid forming this thin annular layer is subjected to a rapid evaporating effect of the heated column 7 and the production of a static film or coat on the heated exchange surface of the column 7 is prevented by action of the wire-loop scrapers 37, 38.

It should be understood that changes or modifications both in the methods as well as in the form, construction, arrangement, and combination of the several parts of the apparatus for evaporating or concentrating liquids may be made and substituted for those herein disclosed and described without departing from the nature and principle of the present invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. Apparatus for concentrating liquids comprising steam-jacketed cylindrical column, a tubular impeller rotatably mounted co-axially within the column, said impeller having a plurality of apertures opening into its interior, a plurality of radially extending blades projecting outwardly, the outer vertical margins of said blades being spaced from the inner wall of the column, pivot blocks rockably mounted upon the rear surface of each of the impeller blades, elongated rods secured to said pivot blocks, a plurality of wire scrapers mounted spacedly upon said rods, each of said scrapers forming a loop at their outer ends, the scrapers being positioned so that the scrapers associated with one blade will be located in line with the spaces between the scrapers associated with the next adjacent blade, and stop pins adjustably mounted in the blades for engagement against the rods to control the outwardly swinging movement of the scrapers through centrifugal action into contact with the walls of said column upon rotation of the impeller blades.

2. Apparatus for concentrating liquids comprising a steam-jacketed cylindrical column, a tubular impeller rotatably mounted co-axially within the column, said impeller having a plurality of apertures opening into its interior, a plurality of radially extending blades projecting outwardly, the outer vertical margins of said blades being spaced from the inner wall of the column, pivot blocks rockably mounted upon the rear surface of each of the impeller blades, elongated rods secured to said pivot blocks, a plurality of wire scrapers mounted spacedly upon said rods in vertical alignment, said scrapers forming loops of generally U-shaped configuration, a central portion of said scrapers being vertically disposed for presenting maximum scraping surface, and stop pins adjustably mounted in the blades for engagement against the rods to control the outwardly swinging movement of the scraper through centrifugal action into con-

tact with the walls of said column upon rotation of the impeller blades.

3. Apparatus for concentrating liquids comprising a steam-jacketed cylindrical column, a tubular impeller rotatably mounted co-axially within the column, said impeller having a plurality of apertures opening into its interior, a plurality of radially extending blades projecting outwardly, the outer vertical margins of said blades being spaced from the inner wall of the column, pivot blocks rockably mounted upon the rear surface of each of the impeller blades, elongated rods secured to said pivot blocks, a plurality of wire scrapers mounted spacedly upon said rods, said scrapers being relatively fine and of loop-forming configuration, the central portion of said scrapers being vertically disposed, said scrapers being bent outwardly at their outer ends for presenting the central vertical portions thereof for scraping contact with the walls of the column, whereby liquid adhering to the inner wall of said column is lifted therefrom by the central portion of said scrapers, and set screws extending through the impeller blades for engagement with the rods in order to control the outward swinging movement of the scraper blades through centrifugal action into scraping contact with the inner wall of said columns upon rotation of the impeller blades.

GEORGE G. ZAHM.

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