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VACUUM DISTILLATION PROCESS AND APPARATUS

Filed June 27, 1946

2 Sheets-Sheet 1

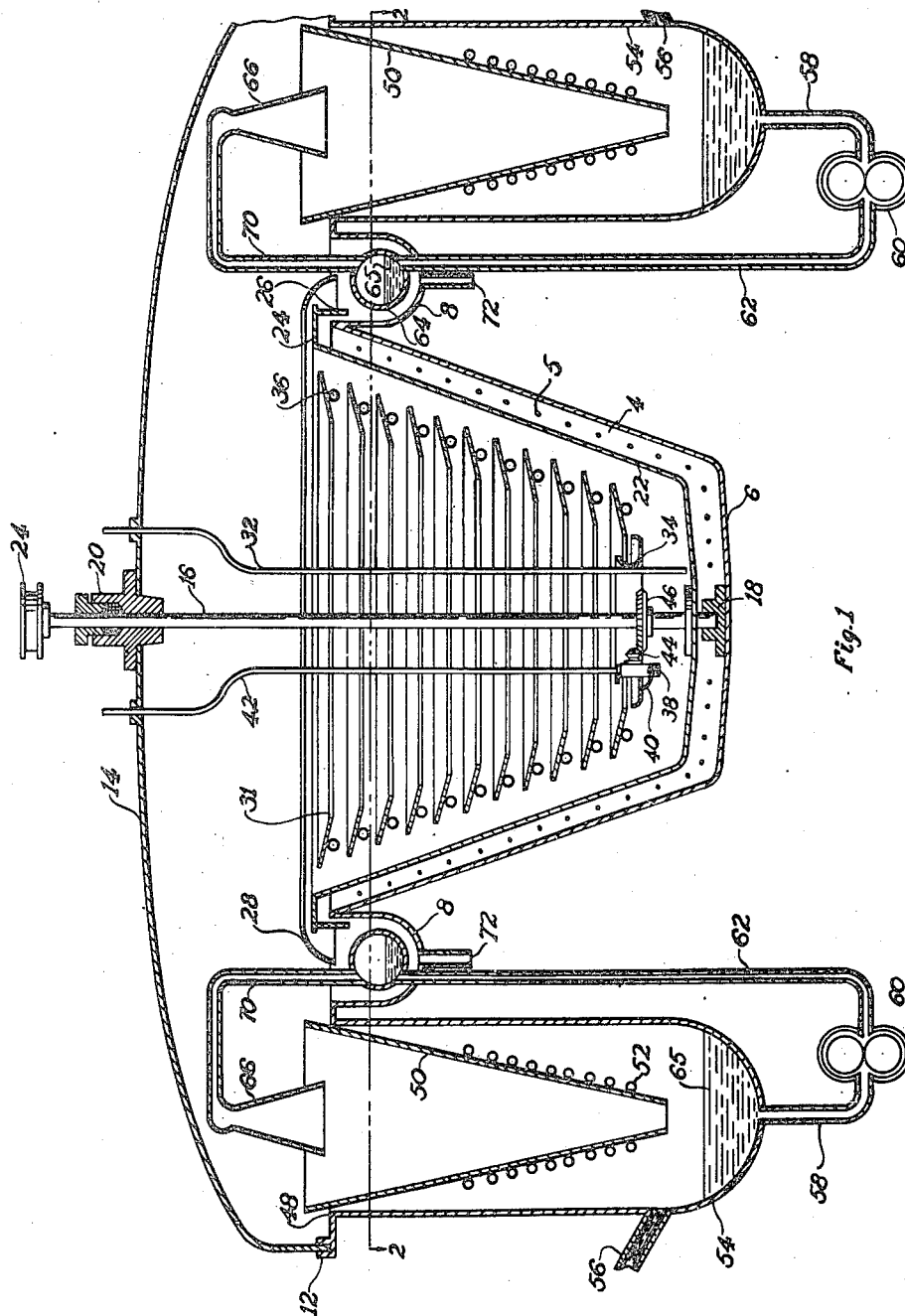


Fig. 1

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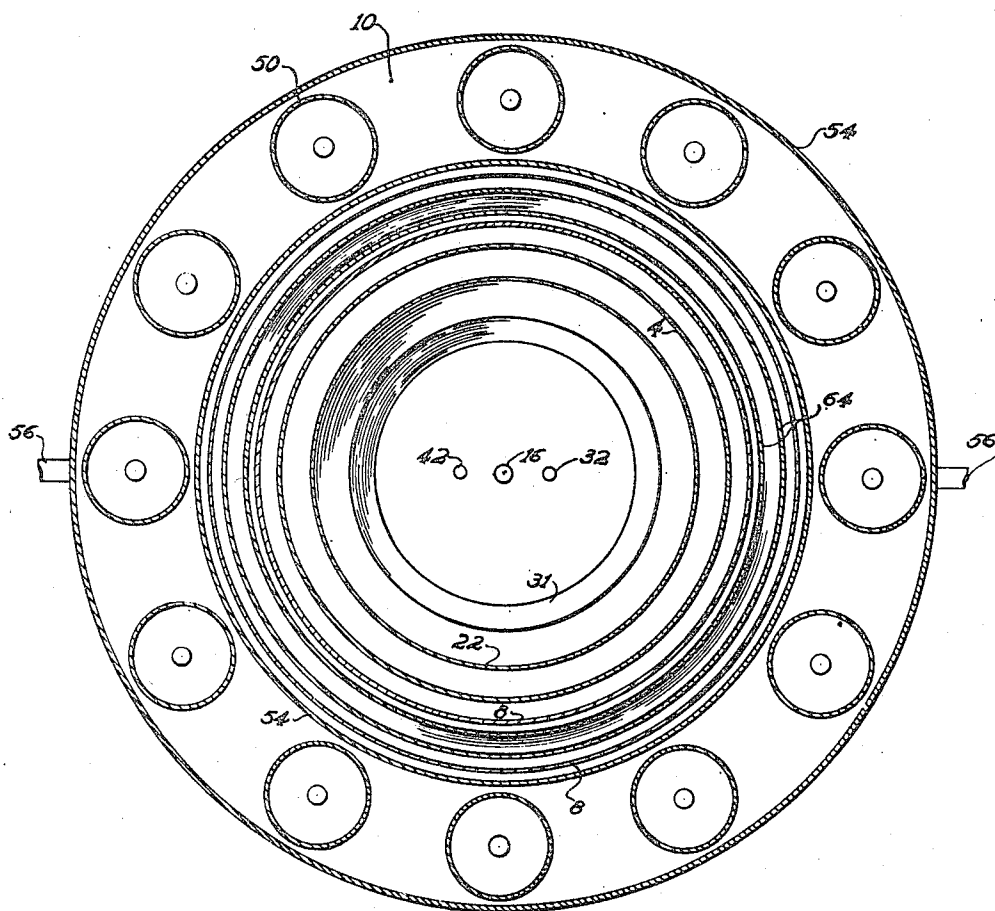


Fig. 2

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VACUUM DISTILLATION PROCESS AND APPARATUS

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7 Claims. (Cl. 202—52)

1

This invention relates to improved vacuum distillation process and apparatus and, in particular, to an improved self-evacuating centrifugal vacuum still.

In Hickman Patents 2,210,927-8, August 13, 1940, there is described improved vacuum distillation process and apparatus wherein the substance to be distilled is caused to flow over a vaporizing surface by centrifugal force, the material being distilled being heated to distillation temperature and hot undistilled residue being removed from the still without utilization of the heat content thereof.

This invention has for its object to provide an improved centrifugal vacuum distillation process and apparatus wherein the heat content of the undistilled residue is utilized to vaporize the actuating fluid in a condensation pump operated to evacuate the still. Another object is to markedly reduce the heat losses which have heretofore been inherent in processes of high vacuum unobstructed path distillation. Other objects will appear hereinafter.

These and other objects are accomplished by my invention which includes high vacuum centrifugal distillation process and apparatus wherein distilland is introduced onto a rotatable vaporizing surface, is caused to flow by centrifugal force to the periphery of said surface and is then quickly brought in heated condition into heat exchange contact with a boiler of a condensation pump containing vaporizable pump fluid which boiler is positioned adjacent the periphery of said surface.

In the following description I have given several of the preferred embodiments of my invention but it is to be understood these are set forth for the purpose of illustration and not in limitation thereof.

In the accompanying drawings wherein like numbers refer to like parts, Fig. 1 is a vertical section of an improved centrifugal vacuum still embodying the principles of my invention and Fig. 2 is a horizontal section taken on line 2—2 of Fig. 1.

Referring to the drawings, numeral 4 designates a conical still casing provided at the base with an integral base 6 and at the top with an integral annular gutter 8 the outer lip of which joins with annular plate 10. Numeral 12 designates an annular groove at the periphery of plate 10 into which still cover 14 fits in a gas-tight manner.

Numeral 16 designates a shaft mounted in the approximate center of base plate 6 and cover 14 and which is rigidly maintained in this position by bearings 18 and 20. The lower portion of shaft 16 is integral with a conical vaporizing surface 22 which is therefore rotatably mounted. Numeral 24 designates a driving pulley at the upper end of the shaft serving to rotate shaft 16 and integral vaporizing surface 22. The upper end of vapor-

2

izing surface 22 is provided with an outwardly turned flange 24 and a collar 26 which protrudes into a stationary annular deflecting member 28. Numeral 32 designates a conduit for introducing distilland onto the inside central portion of conical vaporizing plate 22. Numeral 5 designates a heating element for heating vaporizing surface 22 to distillation temperature.

Numeral 31 designates a plurality of annular collars mounted inside vaporizing cone 22 which act as condensing surfaces. These collars are positioned so that liquid collecting on an upper collar drops onto the next lowest collar and eventually drains into an annular gutter 34. These condensing members 31 are cooled by integral cooling conduits 36 through which cooling fluid is circulated. Numeral 38 designates a stationary pump, the intake side of which is connected to conduit 40 leading to gutter 34 and the exhaust side of which pump is connected to conduit 42 leading to the outside of the still. Pump 38 is driven by gear 44 which meshes with gear 46, integral with shaft 16.

Collar 10 is provided with a number of circular holes 48 in which are mounted cone diffusing tubes 50 which are cooled with integral cooling coils 52 through which cooling fluid is circulated. Immediately below openings 48 and integral with plate 10 is mounted an annular double walled element 54 having a cup shaped cross section to which is connected withdrawal conduits 56 leading to backing pumps (not shown). The lower portion of 54 is connected to a conduit 58 which leads to the intake of a plurality of withdrawal pumps 60, the exhaust sides of which are connected by conduits 62 to annular boiler 64 which surrounds the upper outer periphery of rotating vaporizing surface 22 and which is positioned immediately below deflector 28. Numeral 65 indicates a low vapor pressure pump fluid contained in boiler 65 and in the lower portion of cups 54. Numeral 66 designates ejector nozzles positioned above each of the openings 48 in plate 10 and numeral 70 designates a conduit connecting boiler 64 to the ejector nozzles.

In operating the apparatus illustrated in the drawings backing pumps (not shown) are connected to conduits 56 and the entire system is thus partially evacuated. Liquid to be distilled is then introduced through conduit 32 and vaporizing surface 22 is caused to rotate by force applied to pulley 24. Heating element 5 is actuated to heat vaporizing surface 22 to distillation temperature. The introduced distilland is caused to flow in a thin film by centrifugal force up the inside wall of cone 22. During passage vapors are generated and condense on cooling collars 31. The liquid condensate drains into gutter 34, is withdrawn therefrom through conduit 40 by pump 38 and is delivered from the still through conduit

42. Hot undistilled residue is directed by flange 24 against the baffle 25 and this hot residue immediately drains therefrom onto boiler 64. The low vapor pressure pump fluid 65 condensed thereon is thus heated to vaporization temperature. These vapors pass through ejector nozzle 66 and this high velocity stream of vapors entrains gases present in the still and forces them through the lower portion of conical element 52 into cup 54 from which they are withdrawn through conduit 55 by the backing pump. The pump fluid is condensed on conical element 50 by the action of cool fluid circulated through conduit 52. This condensed pump fluid flows into pump 60 and is forced back into boiler 65 where it is again re-vaporized.

It is preferred that a condensation pump working fluid be selected which has a boiling point, at the pressure in the still, which is 20° to 30° C. below the temperature of the residue oil spread on the surface of boiler 64. The only requisite however is that it be vaporizable at the pressure existing in the boiler and at the temperature of the residue which, of course, varies depending on the material being distilled. Examples of suitable fluids are the phthalic acid esters such as dimethyl, di-butyl etc. phthalates, similar sebacic acid esters, petroleum fractions of low vapor pressure, diphenyl and chlorinated diphenyls, etc.

What I claim is:

1. A high vacuum distillation process which comprises in combination subjecting distilland to distillation by introducing it onto the approximate center of a heated rotating surface maintained in a space under high vacuum, causing distilland to flow over the heated surface in a thin film by centrifugal force, condensing vapors thus generated from the distilland, immediately bringing undistilled residue flowing from the periphery of the rotating heated surface into thermal contact with a boiler positioned adjacent the periphery, transferring the heat from the undistilled residue to a low vapor pressure liquid in the boiler, forming the vapors of the low vapor pressure liquid thus generated into a jet and entraining gases from the space in which the vaporizing surface is positioned in this jet.

2. A high vacuum unobstructed path distillation process which comprises in combination subjecting distilland to distillation by introducing it onto the approximate center of a heated rotating surface maintained in a space under high vacuum, causing distilland to flow over the heated surface in a thin film by centrifugal force, condensing vapors thus generated upon a condensing surface separated from the rotating surface by substantially unobstructed space, immediately bringing undistilled residue flowing from the periphery of the rotating heated surface into thermal contact with a boiler positioned adjacent the periphery of the rotating surface, transferring the heat from the undistilled residue to a low vapor pressure liquid in the boiler forming the vapors of the low vapor pressure liquid thus generated into a jet and entraining gases from the space in which the vaporizing surface is positioned.

3. A high vacuum unobstructed path distillation process which comprises in combination subjecting distilland to distillation by introducing it onto the approximate center of a heated rotating vaporizing surface maintained in a space under high vacuum, causing distilland to flow over the heated surface in a thin film by centrifugal force, condensing vapors thus generated from the distilland upon a condensing surface separated from

the rotating surface by substantially unobstructed space, immediately bringing undistilled residue flowing from the periphery of the rotating heated surface into thermal contact with a boiler positioned adjacent the periphery, transferring the heat from the undistilled residue to a liquid in the boiler having a boiling point at the pressure in the distilling space of 20-30° below the temperature of the undistilled residue, forming the vapors of this liquid into a jet and entraining gases from the space in which the rotating surface is positioned in this jet.

4. A high vacuum distillation process which comprises in combination subjecting distilland to distillation by introducing it onto the approximate center of a heated rotating surface maintained in a space under high vacuum, causing distilland to flow over the heated surface in a thin film by centrifugal force, condensing vapors thus generated from the distilland, immediately bringing the undistilled residue flowing from the periphery of the rotating heated surface into thermal contact with boiler means substantially surrounding the periphery of the rotating surface, transferring the heat from the undistilled residue to a low vapor pressure liquid in the boiler means, forming the vapors of the low vapor pressure liquid thus generated into jet means surrounding the periphery of the rotating surface and entraining gases from the space in which the vaporizing surface is positioned in said jet means.

5. A high vacuum still provided with a rotatable vaporizing surface over which distilland is caused to flow by centrifugal force characterized by a boiler positioned adjacent the periphery of the vaporizing surface, means for directing undistilled hot residue onto the boiler, a low vapor pressure liquid in the boiler, a jet nozzle, means for conveying vapors of low vapor pressure liquid from the boiler to the nozzle, means for entraining gases from the high vacuum still in the jet of vapors issuing from the nozzles, means for condensing the vapor jet and means for returning the condensate to the boiler.

6. A high vacuum still provided with a rotatable vaporizing surface over which distilland is caused to flow by centrifugal force characterized by a boiler positioned adjacent the periphery of the vaporizing surface, means for directing undistilled hot residue onto the boiler, a liquid in the boiler having a boiling point 20-30° less than the temperature of the hot undistilled residue, a jet nozzle, means for conveying vapors of low vapor pressure liquid from the boiler to the nozzle, means for entraining gases from the high vacuum still in the jet of vapors issuing from the nozzle, means for condensing the vapor jet and means for returning the condensate to the boiler.

7. A high vacuum unobstructed path still provided with a rotatable vaporizing surface over which distilland is caused to flow by centrifugal force characterized by boiler means positioned adjacent the periphery of the vaporizing surface, means for directing undistilled hot residue onto said boiler means, a low vapor pressure liquid in the boiler means jet nozzle means attached to said boiler means surrounding the periphery of the vaporizing surface, means for conveying vapors of low vapor pressure liquid from the boiler means to the nozzle means, means for entraining gases from the high vacuum unobstructed path still into the vapors issuing from the nozzle means, means for condensing the vapors and means for returning the condensate to the boiler.

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