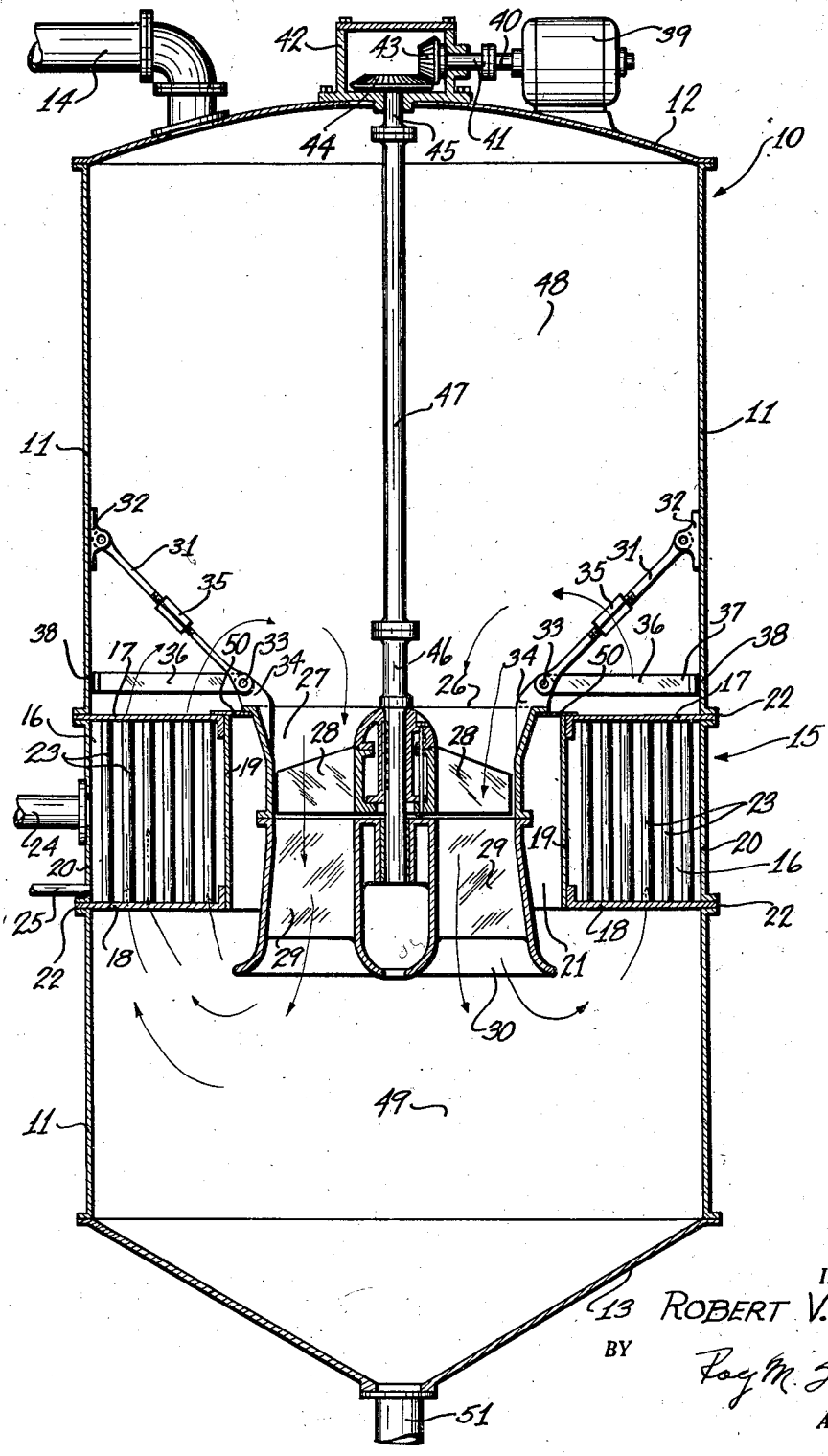
Jan. 25, 1938. R. V. COOK 2,106,295

EVAPORATOR

Filed June 13, 1935



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Patented Jan. 25, 1938

2,106,295

UNITED STATES PATENT OFFICE

2,106,295

EVAPORATOR

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Application June 13, 1935, Serial No. 26,409

1 Claim. (Cl. 159—25)

This invention relates to improvements in evaporators, and more particularly to improved circulating and agitating means for evaporators, or the like.

In older prevailing evaporator installations of a type employing forced circulation of the liquor or fluid to be treated, the fluid is generally transferred from the bottom of the evaporator tank to the top of the tank by means of a pump of suitable type. The piping and pumping equipment in such installations is, in nearly all cases, arranged externally of the evaporator tank; hence, during the transfer of the liquid from the lower to the upper portion of the tank, the fluid is entirely removed therefrom. The loss of heat resulting from the removal of the fluid from the tank during such transfer, materially affects the efficiency of the evaporator system. In addition, the arrangement and disposition of the piping and pumping equipment externally of the evaporator adds considerably to the cost and space requirements of the installation. Hence, it is an object of the present invention to provide an improved evaporator assembly in which the circulating and agitating equipment is operatively secured entirely within the evaporator tank, whereby to secure an increased hydraulic and thermal efficiency of the system, and to obviate the several objectionable features of the older prevailing installations, hereinabove indicated.

Another object is to provide, in connection with apparatus of the type described, an improved pumping assembly mounted within the evaporator chamber for circulating the fluid downwardly in the central portion of the chamber, through the pump assembly and thence upwardly in the evaporator chamber.

A further object is to provide an improved evaporator of the type described, in which the fluid circulating pump is suspended, within the evaporator, from the walls of the evaporator tank, the arrangement being such that the load of the pump and appurtenant parts is distributed over the vertical walls of the tank by spaced tie-rods or other tension members.

Yet a further object of the invention is attained in a pump structure of improved type for circulation of liquor within the tank or pan of an evaporator, the pump assembly including a suction or entrance cone, a runner, a diffuser and a discharge cone, the latter element functioning in the operation of the pump to restore the velocity of the fluid discharging through the pump.

A still further object is to provide an improved evaporator in which the pumping equipment is mounted within the evaporator as an integral part of the evaporator assembly, so that the entire circulation and agitation of the fluid is confined within the evaporator tank, whereby to obtain a more uniform velocity of the fluid through the evaporator assembly, and a more uniform and rapid fluid evaporation than has heretofore been possible of attainment in the older prevailing types of evaporator equipment.

Further objects and advantages will appear from the following detailed description of parts and the accompanying drawing, which is a longitudinal sectional elevation of a preferred form of evaporator assembly embodying the improvements of the present invention.

Referring to the drawing by characters of reference, the numeral 10 designates, generally, a preferred form of evaporator assembly which comprises, essentially, a body portion or tank 11, having end closure portions or covers 12 and 13 which may be secured to the tank in any suitable manner. In the chemical or heat treatment of fluids, the solution or liquor to be treated is delivered to the interior of the tank through a conduit or feed pipe 14 which is suitably secured to the upper closure portion 12 of the tank. Disposed intermediate the end portions 12 and 13 of the tank 11, is an evaporator or heater unit, which is preferably of circular form, and self-enclosed, the heater being generally designated at 15, and includes a chamber 16 arranged concentrically of the tank 11. The chamber enclosing structure is, by preference, built into and supported by the tank 11 and comprises horizontal plates or wall portions 17 and 18, a cylindrical inner wall 19, and a cylindrical outer wall 20. The wall 19 serves, in addition, to define a central well or chamber 21 opening into the tank chamber, the well being provided for a purpose which will presently appear. The wall portions 17, 18, 19 and 20, may be secured together as by welding, riveting or in any other desired manner (not shown), it being noted that the outer cylindrical wall element 20 also constitutes an intermediate outside wall of the evaporator tank or pan structure, being secured to the wall sections above and below as by external flange joints 22.

A plurality of equally spaced tubes 23 extend between and through the plate members 17 and 18 with their ends expanded or otherwise secured in fluid-tight relation to the plates, the tubes opening into the tank chamber so that the fluid admitted to the interior of the tank may

be cycled through them. A pipe or conduit 24 is, by preference, secured to the outer wall 20, and is directed into the chamber 16, for conducting steam or other suitable heating medium into the chamber. The heating fluid circulates about the tubes 23 within the chamber 16, thus heating the tubes and, by conduction, the liquor passing through the tubes. Suitable return piping 25, for condensate drainage, is connected to the chamber 16, when steam is utilized as a source of heat. It will be readily observed that the temperature of the liquor under treatment is raised in passing through the tubes 23, the resulting rapid heat transfer causing evaporation of the fluid.

As a means for agitating and circulating the liquor within the tank and through the heater unit 15, the evaporator assembly is provided, in the central wall or chamber portion 21 of the tank, with a propeller type pump, generally designated at 26, the pump being, by preference, dependingly supported from the vertical tank walls, by means presently to be described. The pump assembly includes, by preference, a suction or entrance cone 27, a runner or propeller 28, stationary diffuser vanes 29, and a discharge cone 30. The pump assembly is preferably suspended from points above the heater unit by means of tie rods 31 which are pivotally secured at their upper ends to eye-brackets 32 secured as by riveting to the side walls of the tank. The lower ends of the tie rods are pivotally mounted on pins 33 engaging eye-bracket members 34, the latter being, by preference, cast integrally with the suction cone 27 of the pump assembly. Each tie rod 31 is, or may be divided, and the divided ends thereof threaded to receive a turn-buckle 35 for effecting adjustment of the pump assembly. To provide additional support for the pump assembly, and to relieve transverse strain on the cone section 27, substantially horizontal distance pieces or braces 36 are disposed between the wall of the tank 11 and the eye-brackets 34. Each brace is pivotally secured at its inner end to one of the brackets 34 by means of the pin 33, and the opposite end 37 is adjustably secured to the side wall of the tank, in any desired manner, for example, suitable shims 38 being provided between the end 37 of each brace, and the wall of the tank, for purposes of lateral adjustment.

The pump or agitator is driven preferably by an electric motor 39 which is, or may be supported externally of the tank on the closure portion 12. The motor shaft 40 is suitably connected to a stub shaft 41 which extends into a gear housing 42 mounted externally of the tank. A bevel gear 43 is secured to the inner end of the stub shaft 41 and engages a bevel gear 44 suitably secured to a stub shaft 45 which extends axially of the pan and vertically through the closure member 12. The stub shaft 45 is connected with the pump propeller or blade shaft 46 by a connecting shaft 47, the ends of which are secured to the stub shafts 45 and 46 in any desired manner. The housing 42 enclosing the bevel gears may, of course, contain a suitable quantity of lubricant for the gears. The pump propeller is so formed that when the pump is driven by the mechanism above described, the liquor in the upper portion 48 of the tank chamber will be forced downwardly, as indicated by the arrows in the drawing, into the lower tank portion 49, first outwardly and thence upwardly through the tubes 23 of the heater 15, and returned to the chamber portion 48. A circular disc or plate 50 is disposed between the upper end of the heater unit and the upper edge of the suction cone 27. Hence, during the operation of the pump, fluid contained in the chamber portion 48 of the tank, must necessarily pass through the pump 26 to the chamber portion 49, since the plate 50 effectively prevents passage of fluid through the well portion 21 of the evaporator assembly. The treated fluid is, or may be removed from the bottom portion of the tank 11 through a pipe or conduit 51 having one end thereof secured to the lower cover 13.

It will be readily understood that by disposing the entire circulating and agitating equipment within the evaporator tank, increased hydraulic and thermal efficiencies are obtained, since the fluid is not removed from the tank at any time during the treating process. In the older prevailing evaporator installations, the fluid in process was conveyed from the bottom of the tank to the top of the tank through a conduit and pumping system arranged exteriorly of the tank. Hence, during the evaporation process, the circulation of fluid was effected partly through the evaporator tank and partly through an external conduit system. In the presently improved arrangement, the circulation is effected downwardly through the pump assembly and thence upwardly through the heater tubes 23, the complete circulation taking place entirely within the tank 11. The improved pumping arrangement herein fully described, is designed to obtain a uniform velocity of flow of the liquor through the evaporator, and to effect a more rapid and efficient evaporating action than has heretofore been possible of attainment in the older prevailing installations. It will be observed that the discharge cone 30 is so formed as to restore the velocity of the fluid discharging through the pump. In the presently improved arrangement, the entire pumping equipment is suspended from above the evaporator or heater unit 15 in such a manner as to relieve the heater structure from supporting any more than a negligible part of the weight of the pumping equipment. The diffuser vanes 29 are, or may be, cast integrally with the discharge cone 30 as a manufacturing expedient, and to minimize the overall length of the pump, and hence of the tank. It will be evident that the entire evaporator assembly, including the internally mounted pumping and circulating equipment, is designed to facilitate ease in assembly, and to minimize space requirements.

The description of the device, its parts, their combination and purposes, has, for brevity, been directed to a device utilized for evaporating liquids by the application of heat. Obviously, the principles of construction and design are equally applicable to apparatus for heat exchanging processes generally, such as cooling equipment, cooking and many others, and accordingly the invention is not to be understood as restricted by stated fields of application. It will, of course, be understood that the present detailed description of parts and the accompanying drawing relate only to a single preferred executional embodiment of the invention and that substantial changes may be made in the described arrangement and construction of parts, without departing from the spirit and full intended scope of the invention, as defined by the appended claim.

I claim:

In combination in a vertical container for the thermal treatment of liquids, a liquid circulating

and heat exchange unit disposed below the normal level of liquid in the container, said unit including a horizontal tank of substantially annular form through which the liquid is to be passed for heat exchange purposes, a pump within the central opening of the tank, the pump being of vertical shaft type and including a propeller type impeller, a plurality of substantially vertical, stationary diffuser vanes disposed immediately adjacent to and extending substantially beyond the pump impeller, an open end tubular body forming a casing about the impeller and constituting a support for said diffuser vanes, the tubular body being formed of two sections connected in a zone substantially between the impeller and vanes, the lower section of the tubular body being flared in a direction away from the pump impeller discharge and terminating in a bell end in a zone substantially below said annular tank, the tank, pump, vanes and tubular body being supported in assembly entirely by the side walls of the container, in a manner to provide a substantially unobstructed circulation space above the said assembly, a liquid inlet in the top of the tank, a liquid outlet at the bottom thereof, a vertical pump shaft extending from the pump impeller to a point externally of the container, and a driving motor for said shaft, located exteriorly of the container.

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