

Sept. 22, 1964

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3,149,570

VAPOR VACUUM LIQUID REMOVAL SYSTEM

Filed March 31, 1958

3 Sheets-Sheet 1

FIG. 1

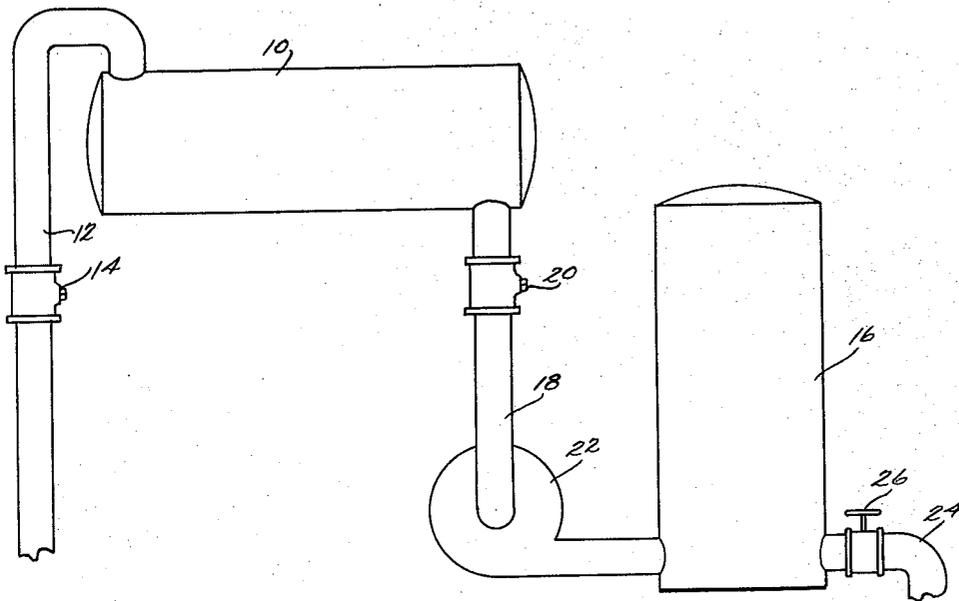
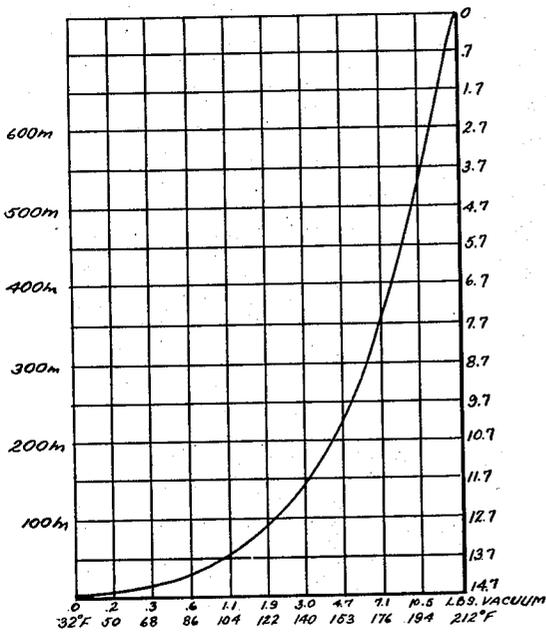


FIG. 2



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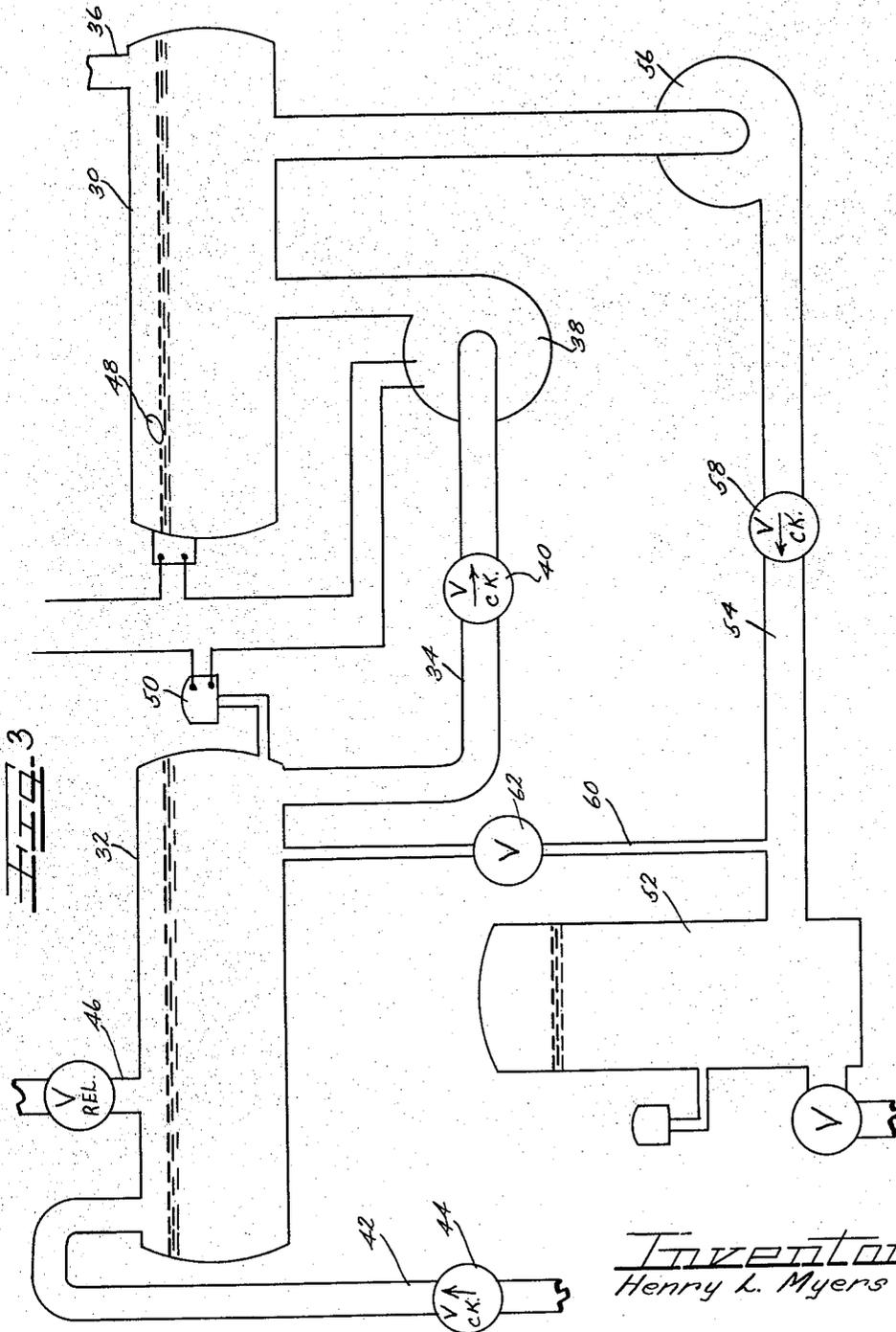
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3 Sheets-Sheet 2



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VAPOR VACUUM LIQUID REMOVAL SYSTEM

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3 Sheets-Sheet 3

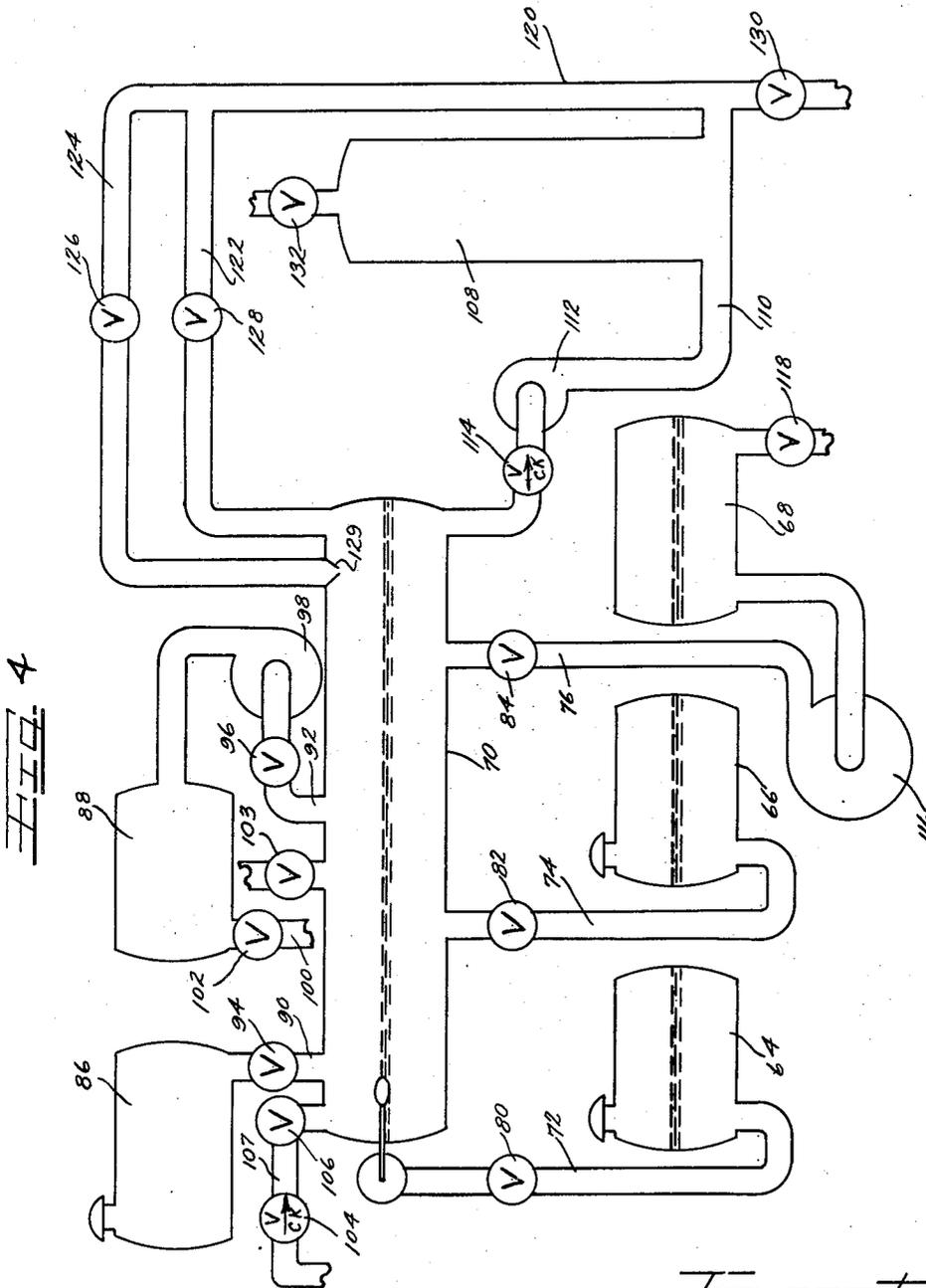


FIG. 4

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BY

Attys

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3,149,570

**VAPOR VACUUM LIQUID REMOVAL SYSTEM**

Henry L. Myers, Colonie, N.Y.; Victoria Nichols, executrix of said Henry L. Myers, deceased, assignor to Victoria Nichols

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4 Claims. (Cl. 103-5)

This invention in part relates to a liquid removal system, and to a method and apparatus for supplying liquids from a source of liquid supply by means of a first tank and pump to a reservoir and/or a pressure tank in a way which eliminates the need for extremely large pressure tanks such as have heretofore been required to store water for use where water is supplied from a well, etc. and also in part to a method for effecting chemical or physical changes in liquids or other material.

Referring to an embodiment of the invention which illustrates these methods or principles, a first tank constructed to prevent collapse due to external pressure is provided which is in communication via a first conduit with a source of liquid, a first valve of the non-return type opening in the direction of the first tank, is disposed in the first conduit between the source of the liquid and the first tank. A second tank is disposed in communication via a second conduit with the first tank, below the liquid level of said first tank, a pump is disposed in the second conduit, and a second valve opening in the direction of the second tank is disposed in the second conduit between the first and second tanks. The pump replenishes the second tank by removing liquid from the first tank and pumps it into the second tank, thus the second valve is opened and held open in response to the movement of the liquid therethrough due to the energization of the pump. When the first tank is full, and upon removal by the pump of an initial, relatively small portion of liquid from the first tank, a vacuum condition is afforded in accordance with the removal of liquid from the first tank which acts to lower the boiling point of the liquid remaining in the first tank. When a further amount of liquid is removed from the first tank, an energy potential is accumulated. The vacuum and energy potential heretofore referred to raises liquid in the first conduit, and the first valve is opened and if of the non-return type is held open by the movement of liquid therethrough. Thus liquid is raised from the source of the liquid to an extent which exceeds the results available within systems of the conventional type. Whereas a continuous application of power is required to lift the liquid from its source and supply it to the conventional, relatively large pressure tank, the present system energizes the pump only in drawing liquid from the first tank to the second tank and when the volume of liquid removed from the first tank by the pump is in excess of the volume of liquid raised from the source of the liquid by the first tank, lifting action is effected in the first tank even after the pressure tank has been replenished and after the pump between the first and second tank has shut off, so that savings in energy are effected.

Accordingly, it is an object of the present invention to provide a vapor vacuum system in which a supply of liquid is available at a marked reduction in energy expenditure and expense where a limited amount of liquid is available at its source in relation to the conduit provided to withdraw it.

Another object of the invention is to provide a system which permits the use of a pressure tank of much smaller dimensions than heretofore required in a given application.

Another object of the invention is to provide a method for effecting chemical or physical changes and purification in liquids or other materials, by the removal of external pressure.

Another object of the invention is to provide a method

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for producing a static pressure limited only in accordance with the molecular structure of the liquid being used to produce said vacuum.

Other objects and advantages of the invention will become apparent as the description proceeds in accordance with the drawings in which:

FIGURE 1 is illustrative of an elementary form of the invention.

FIGURE 2 is a diagrammatic disclosure of the relationship involved in the pumping system of the invention.

FIGURE 3 is illustrative of an embodiment of the invention.

FIGURE 4 is illustrative of another form of the invention.

Referring now to FIGURE 1, a vapor vacuum energy accumulation tank 10 is shown which is in communication with a source of supply (not shown) by means of a conduit 12 provided with a valve 14. If said valve is of the non-return type it opens in the direction of the tank 10. The valve 14 is opened and if of the non-return type is held open as liquid is moved therethrough. The conduit 12 is shown leading into the upper portion of the tank 10, but could connect with the tank at other points thereof if desired. A pressure tank 16 is disposed in communication with the tank 10 by means of a conduit 18 provided with a valve 20 opening in the direction of the tank 16. The valve 20 is opened and held open as liquid is moved therethrough. A pump 22 is disposed intermediate the tanks 10 and 16 in the conduit 18 and is operated by manual control (not shown), or otherwise, in order to lead liquid from the tank 10 into the tank 16 as required. The tank 16 is also provided with a conduit or outlet 24 which is selectively controlled by a manual valve or service faucet 26. Removal of liquid from tank 10, by the pump 22, will open the valve 20, and when a relatively small amount of liquid is removed from the tank 10, a vacuum condition will be set up, equal to the vapor pressure of the liquid which remains in the tank 10. Further removal of liquid from the tank 10 by the pump 22, will then accumulate vapor energy in the tank 10 which is proportionate to the volume of liquid removed. This vapor energy condition is achieved over a very short period of time determined in relation to the surface area of the liquid exposed to the vacuum in tank 10, and coacts with the volumetric reduction in a manner which provides a stored energy potential and a powerful lifting action which is measured in volumetric liquid lift, i.e., liquid lift energy accumulated in tank 10 capable of lifting a volume of liquid to the liquid's maximum barometric lift (FIGURE 2, "WLG" and "XWL"), said volume determined in accordance with the liquid volume removed from the tank.

Thus, if the water at a temperature of 50° F. is the material being used in the system, the boiling point in relation to the potential elevation of the liquid is adjusted by taking .2 pound gage vacuum from 14.7 pound gage vacuum, and this figure of 14.5 pounds gage vacuum is multiplied by a factor representing the liquid lifting force per pound of gage vacuum, liquid lift of water being 2.3 feet per pound of gage vacuum (i.e., 14.5 x 2.3). Potential elevation must be further adjusted by height above sea level.

Again referring to FIGURE 1, after the pressure tank 16 is replenished and the pump 22 is shut off, and if at such time the tank 10 is less than filled, the vacuum and accumulated energy in the tank 10 will still be available to draw liquid thereinto, in readiness for a further demand from tank 16. Since no direct application of external power is required at such time, and where the volume of liquid is limited at its source, in relation to the conduit 12 provided to withdraw it, considerable savings in cost of operation are achieved, and it will also

be seen that a much smaller volume of pressurized liquid is required at any given time as compared with conventional systems. As the conventional application of heat to liquid alters the liquid's density, the present system, by the removal of external pressure from the liquid, also alters the liquid's density.

As seen in FIGURE 3, an auxiliary supply tank 30 may be provided, which communicates with a tank 32 by means of a conduit 34. The tank 30 is vented to atmosphere at 36 so that no great amount of energy is required to pump liquid into tank 30, a pump 38 being utilized for this purpose. A valve 40 opening in the direction of the tank 30 is provided which closes the conduit 34 when the pump 38 is inoperative. The valve 40 is opened and held open as liquid is moved therethrough. The tank 32 draws liquid from a source of supply (not shown) by means corresponding to the embodiment of FIGURE 1. Thus a conduit 42 opens into the tank 32 and has a check valve 44 which opens and is held open as liquid is moved therethrough, in accordance with the liquid lifted in the conduit 42, in response to a vacuum condition in the tank 32. A valve 46 is provided, opening in the direction of the atmosphere, for the tank 32, which opens in response to a vapor or air pressure which is preferably substantially one pound greater than atmospheric pressure, the pressure being produced in accordance with the liquid flow in the hereinafter described conduit 60, it being noted here that if tank 32 and tank 30 are at the same height, then valve 40 must be biased to closing with a spring pressure sufficient to permit the proper purging action and operation of valve 46. Thus the tank 32 is kept in readiness for further action in drawing liquid from a source of supply.

In order to afford automatic operation, the pump 38 is connected to a source of power by means of the closing of the switch contacts of a float control 48 in the tank 30, which is in series circuited arrangement with the contacts of a vacuum control switch 50 in the tank 32. Thus when the water level in the tank 30 reaches a predetermined low, the control 48, in cooperation with the vacuum control 50, operates to permit the energization of the pump 38, and, likewise, when pressure within the tank 32 reaches substantially two pounds above atmospheric pressure, the switch 50, in cooperation with the float 48, operates to permit the energization of the pump 38. This switch 50 will open at a vacuum below atmospheric pressure such as to effect the extent of evacuation desired in tank 32.

A pressure tank 52 is provided which may have an outlet conduit 51. A pressure control 53 resides in the tank 52, which may control the operation of the hereinafter described pump 56, in a manner that is well known in the art. Tank 52 communicates with the tank 30 by means of a conduit 54, and a pump 56 is disposed in the conduit 54 for selective operation to maintain a desired level in the tank 52. A suitable valve 58 which opens and is held open by the movement of liquid therethrough, is disposed in the conduit 54. A conduit 60 affords communication between the conduit 54 and tank 32 and is provided with valve capillary means 62 which may be opened slightly as desired to permit a small amount of liquid to flow from the tank 52 into the tank 32, so as to expel the free air or gas content removed from the liquid that had been contained in the tank 32, from the tank 32 through valve 46 and to expel any air or gas content that may have been introduced into the system from the source of the liquid and also to close the switch 50. This function will be evidenced upon completion of a liquid drawing cycle of the tank 32. Various forms of the pumps 38 and 56 may be utilized, as will be understood by those skilled in the art.

Referring now to FIGURE 4, a schematic drawing of a system is shown for the purpose of illustrating a few of the principles inherent in the invention as disclosed

in the preceding embodiments. This system includes a plurality of tanks 64, 66, and 68 communicating with the tank 70 by means of conduits 72, 74, and 76 respectively, valves 80, 82 and 84 controlling the extent of this communication. A pair of tanks 86 and 88 are disposed above the tank 70 and communicate therewith by means of conduits 90 and 92 respectively, controlled by valves 94 and 96. The conduit 92 is provided with a pump 98 whose function in illustrating the principles of the invention will be hereinafter further described.

The tank 88 is vented at 100 by means of a manually operable valve 102, while the tank 70 is also vented by means of valve 103. Valves 104 and 106 are in a conduit 107 which is in communication with tank 70 and a source of liquid (not shown). Valve 106 may be adjustable to limit the flow of liquid into the tank 70. A pressure tank 108 communicates with the tension tank 70 by means of a conduit 110, in which a pump 112 is disposed as hereinafter further described, which opens valve 114 by the movement of liquid therethrough, during removal of liquid from tank 70. Another pump 116 is disposed in a conduit 76 for the tank 68, and this tank is vented by a manually controlled valve 118. A heating means 119 may be provided for the tank 70 to produce turbulent boiling in liquid in the tank.

Pressure tank 108 may be vented by valve 132, and communicates with the tank 70 by means of a conduit 120 which is bifurcated at 122 and 124 and provided with valves 126 and 128, the conduit 124 being equipped with a mist nozzle 129 to promote further vaporization. The end of the conduit 120 may release the supply of liquid from tank 108 by means of a valve 130.

As indicated above, the system of FIGURE 4 is shown to illustrate other principles inherent in the invention. Thus, when pump 112 is operated, opening valve 114 and partially opening either valve 126 or 128, will afford a continuous cycle for the liquid to move in, thus producing a vaporous vacuum condition in tank 70 and a pressure condition in tank 108.

When valves 96 and 102 are opened, and pumps 98 and 112 are operating, gas may be removed from the tank 70. Further adjustment may be provided by injecting liquid and removing gas or vapor, this being accomplished by opening valves 96 and 102 as hereinafter described, and by opening valves in other points of the system such as valves 80, 82, or 128, while running the pumps 98 and 112. Other adjustments of the valves will permit controlled injection of liquid into the system or removal therefrom of gas or vapor.

When pumps 98, 112 and 116 are operating and valves 84, 118 and 94 are opened and the previously described valves are also opened, liquid and gas or vapor may be simultaneously injected into the tank 70 and removed therefrom. This may also be accomplished by opening valve 126 or 128 and valves 80, 82, 94, 96 and 130.

When pump 112 is operating and the tank 108 is full and valve 132 is opened to vent the tank to atmospheric pressure and then closed, opening valve 126 serves to create a further vaporization in tank 70 and affords a continuous cycle.

If tank 66 is used to contain a gas rather than a liquid, and tank 86 contains a liquid instead of a gas, then the system will permit gas rising from tank 66 through the liquid in tank 70 to be partially absorbed and entrained in the liquid of tank 70. Similarly, liquid released from tank 86 and falling through the vapor portion of tank 70 would be partially absorbed in the vapor therein contained. Conversely, some of the vapor in the tank 70 would also be absorbed in the falling liquid from tank 86.

Accordingly, the vapor vacuum pumping system of the invention may be utilized in oxygenation of the blood and intravenous feeding or the like. This may be ac-

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complished by operating pump 112, with valve 114 open and valves 126 or 128 partially opened, introducing the blood from the patient through valves 104 and 106, in accordance with known methods and techniques, and returning it to the patient through valve 130. Oxygen and nutrient fluids may be infused into the blood through controlled use of the valves 82 and 94, in conjunction with tanks 66 and 86, through conduits 74 and 90.

Also, removing the external pressure from liquids in accordance with the system of the invention serves to release the entrained air and gases from the liquids, so that bacteria are arrested or destroyed. Thus, the system is useful for purifying and preserving liquids.

In another application, a liquid having a relatively high boiling point may be used in the system, and a liquid of relatively low boiling point infused into association with the liquid of high boiling point, or its vapor, so that the low boiling point liquid would be brought quickly to a state which corresponds to a point substantially in excess of its boiling point.

Likewise, enclosure of a liquid and removal of liquid from the enclosure, as well as physical expansion of the tank, as by piston 65 in tank 64, will achieve a vapor vacuum condition as described.

Also, infusing two materials into the system adapted to react chemically to produce heat, as for example an acid and an alkali, will effect an expansion effective to expel a portion of either or both of the materials in the liquid state, so that when the tank is closed and cooling causes condensation, a vapor-vacuum will be achieved which will place the remaining liquid as its boiling point. Upon the application of external heat to the tank, a turbulent boiling will then be produced. A rapid vaporization or boiling state can be attained, in the present system by a relative vacuum produced by the action of the liquid itself; the relative vacuum being approximately 14.7 pounds per square inch gage. Any liquid, or solid brought to the liquid state, can thus attain its relative vacuum, this relative vacuum (absolute pressure), is limited as to extent, only by the molecular structure of the liquid. Thus the density of liquids can be readily altered in the system of the invention.

Although a less than sealed system, i.e., a system where the inlet from the source of the liquid is open or partially open during pumping, could be used to produce results in the analysis of my vapor vacuum system, said system would not achieve as great an energy content per gallon of liquid removed from tanks 10, 32 or 70 as would be produced by a sealed system, i.e., a system where the inlet from the source of the liquid is closed during pumping.

The system affords a removal of external pressure which is effective to provide a wide variety of chemical or physical changes in liquids or other materials similar to the changes produced by thermal energy so that various refrigeration or heating cycles, and boiling and vaporization of matter at suitable temperature may be readily achieved, it being understood that application of heat may be utilized to these ends in cooperation with the system of the invention.

The system achieves the point of rapid vaporization or boiling, for matter in the liquid state, more rapidly than can be achieved by the use of heat alone, this point being reached when the vacuum produced (static pressure), equals the vapor pressure of the matter used to produce said vacuum. For example, if a material such as lead be heated to its melting point and enclosed in a tank of a material of higher melting point, such as steel, removal of a small volume of lead by suitable pump means will produce a vacuum which places the lead remaining enclosed, at its boiling point. Removal of more of the lead then produces a vapor vacuum equal to the cubic inch volume of the lead thus removed. This effect will be produced for any liquid (or solid heated

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above its melting point). The liquid may then be made to boil violently by the application of but a slight amount of additional heat.

If a liquid which has been subjected to a vacuum condition in this system is again introduced into a tank and treated in the same way, the boiling point will be reached after a smaller volume of liquid has been removed than was removed in the first instance, because of the removal, by the first vacuum of gases entrained in the liquid. A greater energy or tension will therefore be provided in the second instance. This result could be accomplished, for example, by a repetition of removing the liquid from tank 70 to tank 108, and venting the gases from tank 70 to atmosphere by introducing the liquid from tank 108 into tank 70.

Although I have described my system with respect to certain principles and details thereof, it will be evident that these may be varied without departing from the spirit and scope of the invention as set forth in the hereunto appended claims.

I claim as my invention:

1. A pumping system comprising a first tank filled to its maximum liquid capacity, first conduit means opening into the first tank and leading from a source of liquid supply, a normally closed first valve in said conduit means, a second tank, second conduit means between said first and second tanks, a normally closed second valve in said second conduit means, a first pump in said second conduit between said first tank and said second tank, said first pump removing liquid from said first tank and creating a vacuum therein, said first pump opening said second valve by moving therethrough which may be received in said second tank, said second tank being vented to atmosphere, a third tank, third conduit means connecting said second tank and said third tank, a second pump in said third conduit means, a normally closed third valve between said second pump and said third tank, a fourth conduit of restricted capacity between said first tank and said third tank, manually controlled capillary valve means in said fourth conduit, said second pump moving liquid from said second tank to said third tank, said second pump opening and holding open said third valve by moving liquid therethrough during the energization of said second pump, said first tank lifting liquid from said source of liquid supply into the vacuum contained therein, and manually controlled outlet means for said third tank.

2. A pumping system comprising a first tank filled to its maximum liquid capacity, first conduit means opening into said first tank and leading from a source of liquid supply, a normally closed first valve in said first conduit means, a second valve of the pressure relief type for said first tank, a second tank, second conduit means between the said first tank and said second tank, a normally closed third valve in said second conduit biased toward closing to a higher degree than said second valve, a first pump located below said first tank in said second conduit means, a first switch control in said first tank the contacts of which are in series circuited arrangement with contacts of a second switch control in said second tank, said first control energizing said first pump in response to a predetermined pressure condition in said first tank, in cooperation with said second control, said first pump opening and holding open said third valve in said second conduit by movement of liquid therethrough as liquid is moved from said first tank to said second tank, said second tank being vented to atmosphere, said second control in said second tank energizing said first pump in response to a predetermined liquid level condition in said second tank in cooperation with said first control in said first tank, a third tank, a third conduit means connecting said second and third tanks, a normally closed fourth valve in said third conduit means, a second pump in said third conduit means between said second tank and said third tank opening said fourth valve

in said third conduit by movement of liquid therethrough as liquid is moved from said second tank to said third tank, a pressure control means in said third tank for the said second pump, a fourth conduit means connecting said first tank to said third conduit subsequent to said fourth valve, a fifth valve in said fourth conduit opened slightly to permit a limited amount of pressurized liquid to flow from said third conduit to said first tank to close the contacts of said first control, and outlet means in said third tank, said first valve opening and being held open by movement of liquid therethrough as said first tank draws liquid from said source of liquid supply.

3. A pumping system comprising a first tank containing its maximum liquid capacity, a first conduit means containing its maximum liquid capacity opening into said first tank and leading from a source of liquid supply, a normally closed first valve in said first conduit means, a second valve of the pressure relief type opening in the direction of atmosphere and residing in the top of said first tank, a second tank, a second conduit means containing its maximum liquid capacity between said first tank and said second tank, a normally closed third valve in said second conduit, a first pump located below said first tank in said second conduit, a first switch control in said first tank which opens its contacts at a relatively low pressure and closes its contacts at a relatively high pressure in response to predetermined pressure conditions in said first tank, a second switch control in said second tank the contacts of which are in series circuited arrangement with the contacts of said first control, said second controls contacts closing a circuit to energize at a low liquid level and opening circuit to de-energize at a high liquid level said first pump in response to predetermined liquid level conditions in said second tank in cooperation with said first control, said first pump opening and holding open said third valve in said second conduit by movement of liquid from said first tank into said second tank, said movement of liquid from said first tank creating a vacuum and vapor in said first tank, said first valve opening and being held open by movement of liquid therethrough as said vacuum and vapor in said first tank lifts liquid from a source of liquid supply, said second tank being vented to atmosphere, a third tank, a third conduit means connecting said second tank and said third tank, a normally closed fourth valve in said third conduit means, a second pump in said third conduit, said second pump when energized moving liquid in said third conduit opening and holding open said fourth valve by means of movement of liquid therethrough, a fourth conduit means between said first tank and said third conduit subsequent to said fourth valve, a fifth valve in said fourth conduit means admitting a limited amount of liquid under pressure from said third conduit to said first tank whereby to expel from said first tank air or gasses removed from the liquid by said vacuum and vapor or any air or gasses introduced into the system from the source of liquid supply, through said second valve after said vacuum and vapor has been diminished by lifting liquid from the source of liquid supply, a third control means in said third tank for operating the second pump, and outlet means substantially at the bottom of said third tank to vent liquid from said third tank.

4. In a method of pumping liquids from a liquid supply to a pressure tank to store said liquid under pressure conditions, the steps of pumping liquid via a first pump from a closed first tank filled to its maximum liquid capacity to an open second tank thereby removing liquid from the first tank to reduce the pressure in the first tank to the boiling point of the liquid and to accumulate an energy potential therein, shutting off said pump, closing communication between said second tank and said first tank in response to the shutting off of said first pump, opening said first tank to a source of liquid supply and lifting liquid from the source of liquid supply into the first tank by energy potential accumulated in said first tank created during said pumping of liquid from said first tank to said second tank, pumping via a second pump from the second tank to a third tank to store the liquid in the third tank under pressure conditions, energizing the first pump in response to the withdrawal of liquid from the second tank by the second pump, shutting off the first pump, lifting liquid from the source of liquid supply by the action of the first pump in response to the action of the second pump and energizing the first pump in response to a predetermined pressure condition in the first tank effected by moving pressurized liquid from the third tank to the first tank.

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,149,570

September 22, 1964

Henry L. Myers, deceased,  
by Victoria Nichols, executrix.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 32, after "moving" insert -- liquid --.

Signed and sealed this 16th day of February 1965.

(SEAL)

Attest:

ERNEST W. SWIDER  
Attesting Officer

EDWARD J. BRENNER  
Commissioner of Patents