

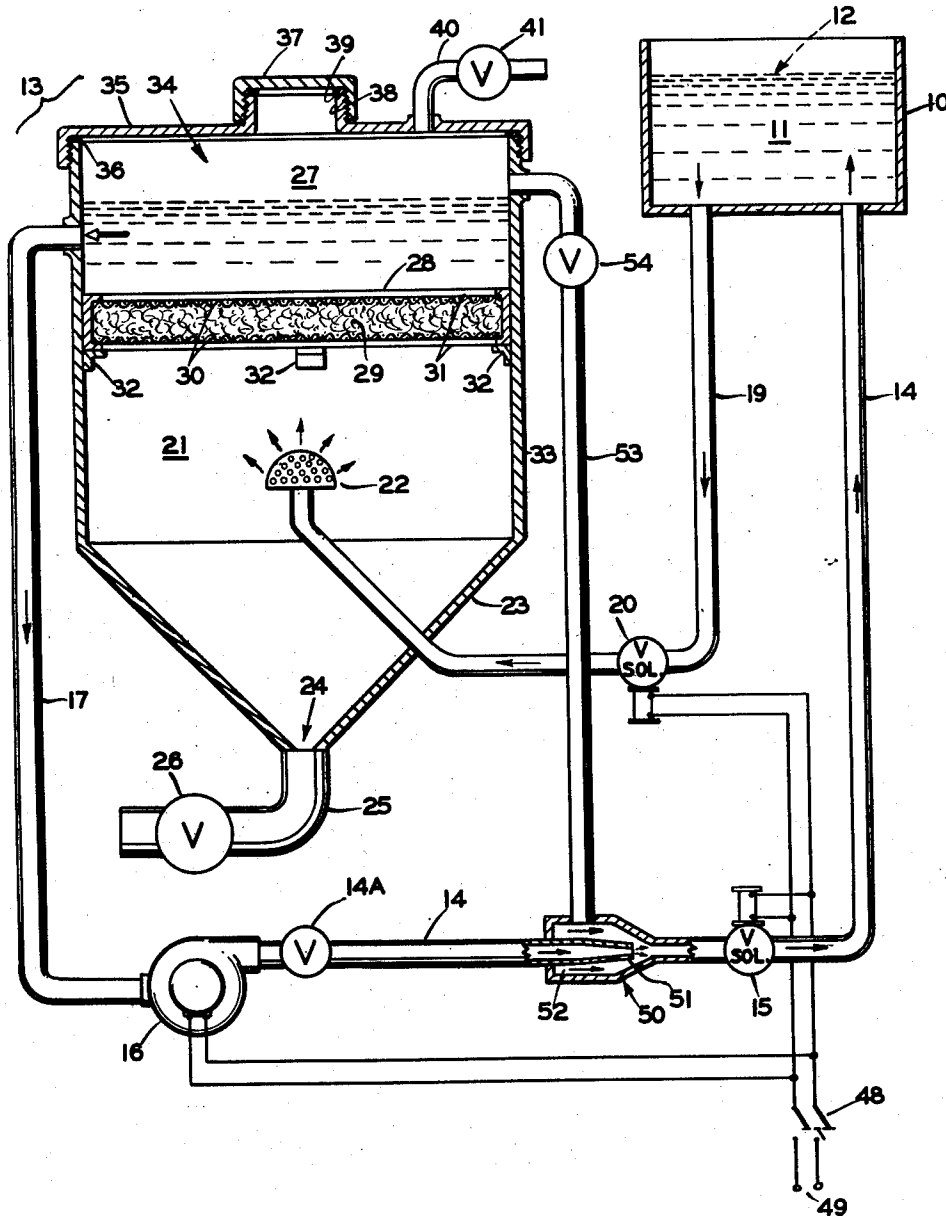
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LIQUID CIRCULATION SYSTEM

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LIQUID CIRCULATION SYSTEM

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8 Claims. (Cl. 137—205)

This invention relates to recirculatory liquid supply systems, and is an improvement on the system set forth in the present inventor's patent application Serial No. 463,789, filed October 21, 1954, for Liquid Recirculating System. In the latter system, liquid is fed from a supply tank to an open point of use, then returned to the tank and subjected to any necessary treatment, such as filtering, before return to the point of use.

A feature of the system is the maintenance of a uniform liquid level in an open receptacle at the point of use, regardless of whether said level is above or below the liquid level in the supply tank. This is in general accomplished by using a centrifugal feed pump and maintaining the tank under reduced pressure, which of course cuts down the pump output. With this arrangement, once the desired level is established and the rate of withdrawal equals the rate of return feed to the tank, any increase in the rate at which liquid is withdrawn by the pump from the tank will increase the tank vacuum and cut down the pump discharge, while any excess of return flow over withdrawal rate will reduce the vacuum and increase the pump discharge. This system thus automatically maintains a recirculation equilibrium, with a uniform liquid level in an open container at the point of use; and when there is no container, it maintains uniform liquid supply and withdrawal rates.

The prior system also includes an arrangement for raising the level in a container. This comprises a valved normally closed pipe connecting the partially evacuated air space at the top of the supply tank to the outer air. By allowing a limited amount of air to enter said space by operating the valve, the vacuum is reduced, and the pump discharge is increased until the level in the supply tank is drawn down to the equilibrium level. During this period more liquid is supplied to the container than is withdrawn, raising the level in the container by an amount commensurate with the amount of air drawn into the tank.

However, in order to reduce the amount of liquid in the recirculation system, which would be effective in lowering the liquid level in a container where such a container is employed at the point of use, it was necessary to withdraw the required amount of liquid from the recirculation system, involving either the waste of the liquid, generally including a detergent or solvent, or the provision of separate storage facilities for the withdrawn liquid.

An object of this invention is to provide a novel arrangement, suitable for use in a system of the indicated type, for lowering the liquid level in a container supplied with circulating liquid.

A further object is to provide a novel, readily regulated arrangement for increasing the vacuum in the tank and thereby reducing by a predetermined amount the quantity of recirculating liquid outside of the tank.

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A related purpose is to utilize the recirculation system to provide the increased vacuum.

An additional object is to provide an arrangement whereby the amount of recirculated liquid outside of the supply tank, and the liquid level in a container at the point of use, when such container is employed, may be raised by control means located at the supply tank, and in particular by control means readily incorporated in a system of the type described in the above-mentioned application.

The foregoing and other objects, purposes and advantages of the invention will appear more fully hereinafter from consideration of the detailed description which follows, in conjunction with the accompanying drawing, wherein one embodiment of the invention is illustrated. It is to be expressly understood, however, that the drawing is for the purposes of illustration and description and is not to be construed as defining the limits of the invention.

In the drawing, the single figure is a schematic diagram of a recirculation system of the indicated type, including the arrangement for raising the liquid level, embodying the invention.

The general system is the same as that disclosed in the above mentioned application, being illustrated in the same manner, with the same numerals indicating corresponding parts. However, for simplicity, the heating arrangement and thermostatic control have been omitted, since they have no relation to the present invention, though these and other liquid treatment features may of course be used in the present system if desired.

The general recirculation system includes open treatment tank 10 containing liquid 11 having a level 12, and means for feeding the liquid from a supply tank 13 through pipe 14 containing solenoid valve 15 by means of centrifugal pump 16 through regulating valve 14a, the pump being supplied through feed pipe 17 from the liquid in tank 13. Liquid 11 in tank 10 is returned to tank 13 through return pipe 19 provided with solenoid valve 20 to sedimentation chamber 21 by means of the distributing rose 22. Solids settling on the tank bottom 23 travel through solids outlet 24 to waste pipe 25 closed by valve 26.

The upper part of tank 13 constitutes supply chamber 27 connected to feed pipe 17 and separated from sedimentation chamber 21 by filter disk 28. This disk may comprise a fibrous filtering material 29 held by wire mesh retaining sheets 30 in channel frame 31 removably supported by brackets 32 on the side wall 33 of tank 13.

The upper part of supply chamber 27 is an air space 34; and tank 13 is sealed by cover 35 threaded on the tank against the sealing gasket 36. The cover may be provided with a small cap 37 threaded on neck 38 against sealing gasket 39. Space 34 is connected with the outer air by level raising pipe valve 40 closed by valve 41.

An arrangement is provided for increasing the vacuum in air space 34, employing evacuating means actuated by the liquid flow. This is advantageously accomplished by the use of an aspirator, which is most effective when located in the pump discharge line 14. In the form illustrated, the aspirator 50 is diagrammatically shown, various forms of aspirators or injection devices suitable for this use being well known in the art. As illustrated, it includes a jet nozzle 51 in the pump discharge line 14 surrounded by intake chamber 52 connected by pipe 53 through valve 54 to air space 34.

In the operation of the apparatus, as set forth in the above-mentioned application, filtered liquid from supply chamber 27 is fed by centrifugal pump 16, at a rate regu-

lated by valve 14a, to the point of supply, such as treatment tank 10, and is returned through pipe 19 and rose 22 to sedimentation chamber 21, solenoid valves 15 and 20 cutting off the feed and return flows when switch 48 to centrifugal pump 16 is open. The rate of discharge of pump 16 is determined by the degree of vacuum in space 34, a higher vacuum producing reduced pump flow and vice versa. When the system is started, the pump 16 develops an increasing vacuum in space 34, progressively cutting down the rate of pump discharge until the rate of supply to the point of use equals the rate of return, at which time the system is in equilibrium and the vacuum is stabilized. Any increase in pump discharge produces an increase in vacuum, which cuts down the discharge to the stabilization rate, while any decrease in pump discharge reduces the vacuum and increases said discharge until conditions are stabilized. When it is desired to raise liquid level 12, valve 41 is opened, introducing a controlled amount of air to space 34, so that the pump discharge is increased until equilibrium is reached, thereby raising the liquid level in tank 10.

Under these conditions the aspirator feed line valve 54 is closed and aspirator 50 is inactive. When a lowering of the liquid level 12 is desired, valve 54 is opened, permitting aspirator 50 to draw air out of space 34, increasing the vacuum. This reduces the discharge from pump 16, so that the return from treatment tank 10 to tank 13 will be greater than the feed to tank 10, thereby reducing liquid level 12 until the equilibrium vacuum in space 34 is reached, at which time the liquid supply to and withdrawal from tank 10 will be equal as already indicated. The operation of valve 54 is of course carefully regulated as to time, extent of opening or both in order to produce the desired quantitative lowering of the liquid level 12. This arrangement has been found highly efficient in practice, one installation operating at a flow rate of approximately four gallons per minute being effective to reduce the volume of liquid in treatment tank 10 at the rate of approximately one gallon per minute, permitting ready regulation of the operation of valve 54 to lower the liquid level by any selected amount by keeping the valve open for a measured period of time.

Although but one embodiment of the invention has been illustrated and described in detail, and certain variations have been indicated, it is to be expressly understood that the invention is not limited thereto. Various other changes can be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

I claim:

1. A liquid recirculation system, comprising a sealed liquid supply container, means for recirculating liquid between said container and a liquid use zone and maintaining an air space in said container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container, and a circulation system including a supply passage connecting the pump discharge to said use zone and a return passage connecting said zone to the container; and means for decreasing the amount of liquid in the zone of use, including an evacuating device connected to said air space.

2. A liquid recirculation system, comprising a sealed liquid supply container, means for recirculating liquid between said container and a liquid use zone and maintaining an air space in said container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container, and a circulation system including a supply passage connecting the pump discharge to said use zone and a return passage connecting said zone to the container; and means for decreasing the amount of liquid in the zone of use, including an aspirator in the liquid circulation system, connected to said air space and actuated by liquid flow in said system.

3. A liquid recirculation system, comprising a sealed liquid supply container, means for recirculating liquid between said container and a liquid use zone and maintaining an air space in said container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container and a circulation system including a supply passage connecting the pump discharge to said use zone and a return passage connecting said zone to the container; and means for decreasing the amount of liquid in the zone of use, including an aspirator in the supply passage, connected to said air space and actuated by the centrifugal pump discharge.

4. A liquid recirculation system, comprising a sealed liquid supply container, means for recirculating liquid between said container and a liquid use zone and maintaining an air space in said container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container, and a circulation system including a supply passage connecting the pump discharge to said use zone and a return passage connecting said zone to the container; and means for decreasing the amount of liquid in the zone of use, including an aspirator in the circulation system actuated by liquid flow in said system and including an air supply chamber; a passage connecting said chamber with the air space in the container, and a control valve in the latter passage.

5. A liquid recirculation system, comprising a sealed liquid supply container, an open use container at the point of use, means for recirculating the liquid between the supply container and the use container and maintaining an air space in the supply container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container, and a circulation system including a supply passage connecting the pump discharge to the use container and a return passage connecting the use container to the supply container; and means for lowering the liquid level in the use container, including an evacuating device connected to said air space in the supply container.

6. A liquid recirculation system, comprising a sealed liquid supply container, an open use container at the point of use, means for recirculating the liquid between the supply container and the use container and maintaining an air space in the supply container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container, and a circulation system including a supply passage connecting the pump discharge to the use container and a return passage connecting the use container to the supply container; and means for lowering the liquid level in the use container, including an aspirator in the liquid circulation system, connected to said air space and actuated by liquid flow in said system.

7. A liquid recirculation system, comprising a sealed liquid supply container, an open use container at the point of use, means for recirculating the liquid between the supply container and the use container and maintaining an air space in the supply container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container, and a circulation system including a supply passage connecting the pump discharge to the use container and a return passage connecting the use container to the supply container; and means for lowering the liquid level in the use container, including an aspirator in the supply passage, connected to said air space and actuated by the centrifugal pump discharge.

8. A liquid recirculation system, comprising a sealed liquid supply container, an open use container at the point of use, means for recirculating the liquid between the supply container and the use container and maintaining an air space in the supply container under reduced pressure, including a centrifugal pump having a liquid intake connected to the supply container, and a circulation system including a supply passage connecting the pump dis-

charge to the use container and a return passage connecting the use container to the supply container; and means for lowering the liquid level in the use container, including an aspirator in the circulation system actuated by liquid flow in said system and including an air supply chamber; a passage connecting said chamber with the air space in the container, and a control valve in the latter passage.

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References Cited in the file of this patent

UNITED STATES PATENTS

1,770,736	Funk	July 15, 1930
2,044,096	Moran	June 16, 1936
2,508,762	Lapple	May 23, 1950
2,583,252	Carraway	Jan. 22, 1952
2,653,116	Whitcomb et al.	Sept. 22, 1953
2,720,314	Booth	Oct. 11, 1955