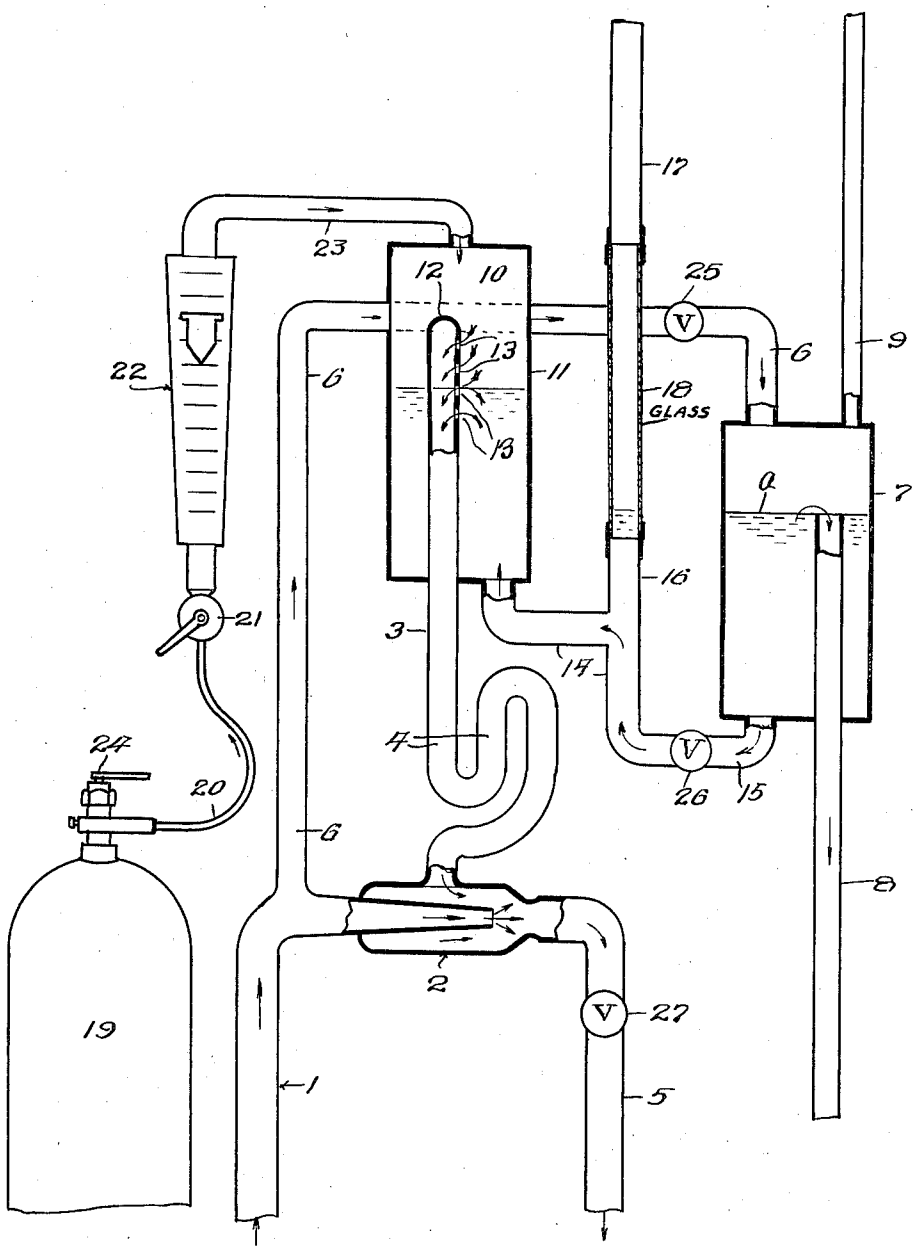
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APPARATUS FOR MIXING GAS AND LIQUID

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APPARATUS FOR MIXING GAS AND LIQUID

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This invention relates to apparatus for mixing gas and liquid, and its principal object is the provision of an apparatus for mixing gas and liquid so as to combine them in a more homogeneous mixture than has been done heretofore.

Ordinarily, gases and liquids do not mix readily but for certain specific purposes it is necessary that they do mix and remain mixed for relatively long periods of time. Ammonia will mix with water and remain in such mixed state for a considerable length of time, whereas gas such as chlorine when mixed with water immediately attempts to revert to its own state.

The present apparatus is very effective for thoroughly mixing chlorine gas with water so that the mixture remains in a mixed state for a considerable length of time.

Another object is to provide a more simple gas and liquid mixing apparatus than has been produced heretofore, one that is unlikely to get out of order and is capable of holding a controlled vacuum, whereby to more effectively mix gas and liquid. Another object is to dispense with float or other valves in the mixing apparatus thereby eliminating the possibility of disabled valves in the apparatus. Another object is the provision of a combination of elements whereby in the event of water failure, the gas can escape only through a vent pipe which leads up and out through the building in which the apparatus is housed, whereby it can do no harm. Another object is the provision of means whereby in the event of any back siphoning in the main water supply pipe, the vacuum in the apparatus immediately becomes broken by the admission of outside air to the main water supply pipe. Another object is the provision of a combination of elements whereby the apparatus may be cleaned by back washing and dirt, sludge and other foreign matter that may have collected in the apparatus may be washed out therefrom without dissembling it.

Although the apparatus of the character described herein may be used for mixing various kinds of gases and liquids for various purposes, it is especially effective in mixing chlorine gas with water for application to cesspools, garbage dumps, swimming pools and practically all other situations where the application of chlorine is required. The invention consists, therefore, in the several novel features, combination and arrangement of parts as will be hereinafter fully set forth and described.

The invention is clearly illustrated in the drawing accompanying this specification in which the figure is a diagrammatic view illustrating a simple embodiment of the invention and showing it in operation.

Referring to said drawing, which is merely schematic, and is not intended as a working drawing, the reference character 1 designates the main water supply pipe to which is connected an aspirator or other suction device 2 which is connected to a mixing chamber, desirably in the form of a pipe 3 having a trap 4 therein. From the discharge end of the aspirator leads a discharge pipe 5 for the mixed gas and water, which pipe leads to the place of application of the gas and water mixture.

Connected to the main water supply pipe 1 is a water pipe 6 which leads to and discharges into the upper end of a water supply tank 7. An overflow pipe 8 leads from a suitable point in the tank 7 down to any place for the discharge of overflow water from the tank 7. The water pipe 6 and overflow pipe 8 serve to maintain a substantially constant, predetermined water level in the tank 7 during normal operation of the apparatus. A vent pipe 9 leads from the top of the tank 7 to a place desirably outside of the building in which the apparatus is housed.

The mixing pipe 3 enters a vacuum chamber 10 desirably contained in a vacuum tank 11 and said mixing pipe extends to a point adjacent the upper end of the tank 11. The top of the mixing pipe 3 is closed as by an end wall 12 and below said closed top the pipe 3 is provided with a series of apertures 13 which may be in the form of holes, slits or slots, and extending along the length of the pipe from a point adjacent its closed top to a place above the normal or static water level in the tank 11. In operation, water enters the mixing pipe 3 through those apertures which are located below the working water level in the vacuum chamber and gas enters the mixing pipe 3 from the vacuum chamber, through the apertures that are located above the working water level.

A water connection is provided between the water supply tank 7 and the vacuum tank 11 which is here shown in the form of a water pipe or conduit 14 which leads from the bottom of one tank to the other. A water trap 15 is provided in the pipe 24 to prevent gas from backing up into the water supply tank 7. Rising from the pipe 14 is a vent pipe 16, 17, in which is interposed a sight glass 18 through which the water level may be observed. The pipe 17 leads up and out through the building in which the apparatus is housed and carries away any gas that may

escape from the vacuum chamber 10 in the event of water failure or back siphoning in the main water pipe, as will be presently explained.

When the apparatus is quiescent, the water level indicated by the character *a*, is maintained in the tank 7, the pipe 14 and the tank 11, which water level is below the lowermost aperture in the pipe 3.

The gas used, is contained in a gas storage tank 19 under high pressure. From the gas storage tank leads a tube 20 which runs to a reducing and regulating valve 21 that is connected to a metering device 22 of conventional form and from the metering device a gas pipe 23 leads to the top of the vacuum tank 11. The gas storage tank has a shut-off valve 24 as usual.

A pump (not shown) or other source of water under pressure connects with the main water supply pipe 1 and serves to supply water to the apparatus under a substantially constant pressure. Some of the water discharges through the water pipe 6 to the water supply tank 7 to replenish water which is withdrawn therefrom by the aspirator 2 when the apparatus is in operation. Surplus water overflows through the overflow pipe 8 whereby a substantially constant water level is preserved in the tank 7. In order to prevent much waste or overflow water in the tank 7, a valve 25 may be interposed in the water pipe 6 which may be adjusted to regulate the flow of water to the tank 7 to correspond with that withdrawn therefrom. A valve 26 may be interposed in the pipe 14 or its water trap 15 which may be adjusted to regulate the flow of water between the tanks 7, 11. This valve 26 may be provided with suitable locking means whereby it cannot be manipulated except by one having authority. The discharge pipe 5 contains a valve 27 by which the discharge pipe may be shut off from the rest of the apparatus when it is desired to clean the same.

In operation, water is supplied to the main supply pipe 1 under pressure, and part of the water flows through the water pipe 6 to the water supply tank 7, and replenishes water drawn off from said tank. Water passing through the aspirator creates suction in the mixing pipe 3 and produces a partial vacuum in the vacuum chamber 10 whereupon the water level in the vacuum tank 11 rises above some of the apertures in the mixing pipe 3 and flows down the same. Gas being admitted to the vacuum chamber 10 from the gas storage tank, enters the mixing chamber in the pipe 3 through the apertures that are above the water level in the vacuum tank 11 and the gas is thoroughly mixed with the water flowing down the pipe 3 to the aspirator, where the mixture is diluted by the water coming through the aspirator from the main water supply pipe. The diluted mixture is discharged through the discharge pipe 5 to the place of application. The amount of gas withdrawn from the gas storage tank 19 is metered in the metering device 22 whereby the amount of gas which it is desired to mix with water during a predetermined length of time can be regulated by adjusting the regulating valve 21. In the event that a higher vacuum is created in the vacuum chamber by the aspirator, the water level therein rises more or less and a greater volume enters the mixing chamber of the pipe 3, and, simultaneously, a proportionately greater velocity of the gas is produced, thereby increasing the amount of gas entering the mixing chamber and maintaining a substantially constant proportion of gas and water.

In the event of water failure and the aspirator therefore ceases to be effective, the gas entering the vacuum chamber builds up a pressure therein, whereupon water in the vacuum tank flows back through the pipe 14 and trap 15 to the tank 7 where it overflows into the overflow pipe 8, and as the pressure within the vacuum tank continues to increase, the water level therein is lowered until the water level reaches a point just below the top of the horizontal part of the pipe 14, thereby permitting the gas to escape into the vent pipe 16, 17, and discharge from the upper end thereof into the outer atmosphere. An attendant observing this condition through the water glass 18 may promptly shut off the supply of gas to the vacuum tank.

In case of back siphoning in the main water supply pipe, the vacuum therein is immediately broken through the water supply pipe 6, tank 7 and vent pipe 9, thereby disabling the action of the aspirator. The water level in the vacuum tank 11 falls to the water level of the tank 7 and water in the pipe 3 will flow down the same and part thereof will be trapped in the trap 4, thereby preventing the escape of gas to the main water supply pipe. If gas pressure is built up in the vacuum tank 11, the water level will be lowered to a point in the horizontal part of the pipe 14 which will permit the gas to escape through the vent pipe 16, 17.

Whenever it becomes necessary to clean the apparatus, the valves 25, 27 are closed, and the gas supply shut off, whereupon the water from the main water supply pipe will pass through the aspirator and up through the pipe 3 and out through the apertures thereof, into the vacuum tank 11, and thence through the pipe 14 and trap 15 to the water supply tank from which it discharges through the overflow pipe.

It is to be understood that the various pipes and parts of the apparatus that come into contact with the gas and liquid mixture and are, therefore, likely to be corroded, are desirably constructed of non-corrosive materials. The several pipes may be composed of rubber tubing and the bodies of the tanks may be composed of glass with rubber ends. Where it is not practicable to use rubber tubing, metal pipes, silver plated on their interior faces, may be employed.

I claim as new and desire to secure by Letters Patent:

1. The combination of a vacuum tank, a source of gas supply under pressure, a gas connection between said source of gas supply and the top of the vacuum tank, a liquid supply tank in which a substantially constant liquid level is maintained, a connection between the lower ends of said tanks whereby the same static liquid level is maintained in the two tanks, a main liquid supply pipe having a pipe leading to said liquid supply tank, a suction device connected to said main liquid supply pipe, and a gas and liquid mixing pipe closed at its top and connected to said suction device, said gas and liquid mixing pipe having apertures opening to the vacuum tank above the static liquid level therein, whereby, when the suction device produces a partial vacuum in the vacuum tank, the liquid level therein rises and liquid discharges through apertures into the mixing pipe and simultaneously gas enters the mixing pipe through apertures above the liquid level and is mixed with the liquid in the

mixing pipe, and a gas and liquid mixture discharge pipe leading from said suction device.

2. The combination of a vacuum tank, a source of gas supply under pressure, a gas connection between said source of gas supply and the top of the vacuum tank, a regulating valve in said gas connection, a liquid supply tank in which a substantially constant liquid level is maintained, a connection between the lower ends of said tanks whereby the same static liquid level is maintained in the two tanks, a main liquid supply pipe having a pipe leading to said liquid supply tank, an aspirator connected to said main liquid supply pipe, a gas and liquid mixing pipe closed at its top and connected to said aspirator, said gas and liquid mixing pipe extending into the vacuum tank and having apertures located above the static liquid level therein, whereby, when the aspirator produces a partial vacuum in the vacuum tank, the liquid level therein rises and liquid discharges through apertures into the mixing pipe and simultaneously gas enters the mixing pipe through the apertures disposed above the liquid level and is mixed with the lquid in the mixing pipe, and a gas and liquid mixture discharge pipe leading from said aspirator.

3. The combination of a vacuum tank, a gas storage tank, a gas connection between said gas storage tank and the top of the vacuum tank, a regulating valve in said gas connection, a liquid supply tank in which a substantially constant liquid level is maintained, a pipe connection between the lower ends of said tanks and having a water trap therein, a main liquid supply pipe having a pipe leading to said liquid supply tank, an aspirator connected to said main liquid supply pipe, a gas and liquid mixing pipe closed at its top and connected to said aspirator, said gas and liquid mixing pipe having a trap therein and having apertures opening to the vacuum tank above the static water level therein, whereby, when the aspirator produces a partial vacuum in the vacuum tank, the liquid level therein rises and liquid discharges through apertures into the mixing pipe, and simultaneously gas enters the mixing pipe through apertures located above the liquid level and mixes with the liquid in the mixing pipe, and a gas and liquid mixture discharge pipe leading from the aspirator.

4. The combination of a vacuum tank, a gas storage tank in which gas is contained under pressure, a gas connection between the gas storage tank and the top of the vacuum tank, a regulating valve and a metering device in said gas connection, a liquid supply tank in which a substantially constant liquid level is maintained, a pipe connection between the lower ends of said tanks and having a trap therein, a main liquid supply pipe having a pipe leading to said liquid supply tank, an aspirator connected to said main liquid supply pipe, a gas and liquid mixing pipe extending up into said vacuum tank, said gas and liquid mixing pipe being closed at its top and having a series of apertures therein located above the static liquid level in said vacuum tank, said gas and liquid mixing pipe having a trap therein and being connected to the aspirator, whereby when the aspirator produces a partial vacuum in the vacuum tank, the liquid level therein rises and liquid discharges through apertures into the mixing pipe, and simultaneously gas enters the mixing pipe through apertures located above the liquid level and is mixed with liquid in the mixing pipe, and a gas and liquid mixture discharge pipe leading from the aspirator.

5. The combination of a main water supply pipe, a water supply tank, a water pipe leading from the said water supply pipe to the upper end of the water supply tank, an overflow pipe leading from said water supply tank, whereby a substantially constant static water level is maintained in said water supply tank, a vacuum tank having a vacuum chamber, a water connection between the lower ends of said tanks, an aspirator connected to said main water supply pipe, a gas and water mixing pipe closed at its top and leading from the vacuum chamber to the aspirator, said gas and water mixing pipe having apertures therein above the static water level in the vacuum tank, a source of gas under pressure, a gas connection between said source of gas pressure and the vacuum chamber, a regulating valve and a metering device in said gas connection, a discharge pipe leading from said aspirator for conveying away the mixed gas and water, a shut off valve interposed in said water pipe, and a shut off valve interposed in said discharge pipe, whereby when said valves are closed, water flows backwards through the apparatus and washes it.

6. The combination of a vacuum tank, a source of gas supply under pressure, a gas connection between said source of gas supply and the top of the vacuum tank, a liquid supply tank in which a substantially constant liquid level is maintained, said liquid supply tank being open to the outer atmosphere, a connection between the lower ends of said tanks whereby the same static liquid level is maintained in the two tanks, a main liquid supply pipe having a pipe leading to said liquid supply tank, a suction device connected to said main liquid supply pipe, and a gas and liquid mixing pipe closed at its top and connected to said suction device, said gas and liquid mixing pipe having apertures opening to the vacuum tank above the static liquid level therein, whereby, when the suction device produces a partial vacuum in the vacuum tank, the liquid level therein rises and liquid discharges through apertures into the mixing pipe and simultaneously gas enters the mixing pipe through apertures above the liquid level and is mixed with the liquid in the mixing pipe, and a gas and liquid mixture discharge pipe leading from said suction device.

7. The combination of a vacuum tank, a source of gas supply under pressure, a gas connection between said source of gas supply and the top of the vacuum tank, a liquid supply tank in which a substantially constant liquid level is maintained, said liquid supply tank being open to the outer atmosphere, a connection between the lower ends of said tanks whereby the same static liquid level is maintained in the two tanks, a vent pipe communicating with the vacuum tank at a place below the static water level therein, a main liquid supply pipe having a pipe leading to said liquid supply tank, a suction device connected to said main liquid supply pipe, and a gas and liquid mixing pipe closed at its top and connected to said suction device, said gas and liquid mixing pipe having apertures opening to the vacuum tank above the static liquid level therein, whereby, when the suction device produces a partial vacuum in the vacuum tank, the liquid level therein rises and liquid discharges through apertures into the mixing pipe and simultaneously gas enters the mixing pipe through apertures above the liquid level and is mixed with the liquid in the mixing pipe, and a gas and liquid mixture discharge pipe leading from said suction device.

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