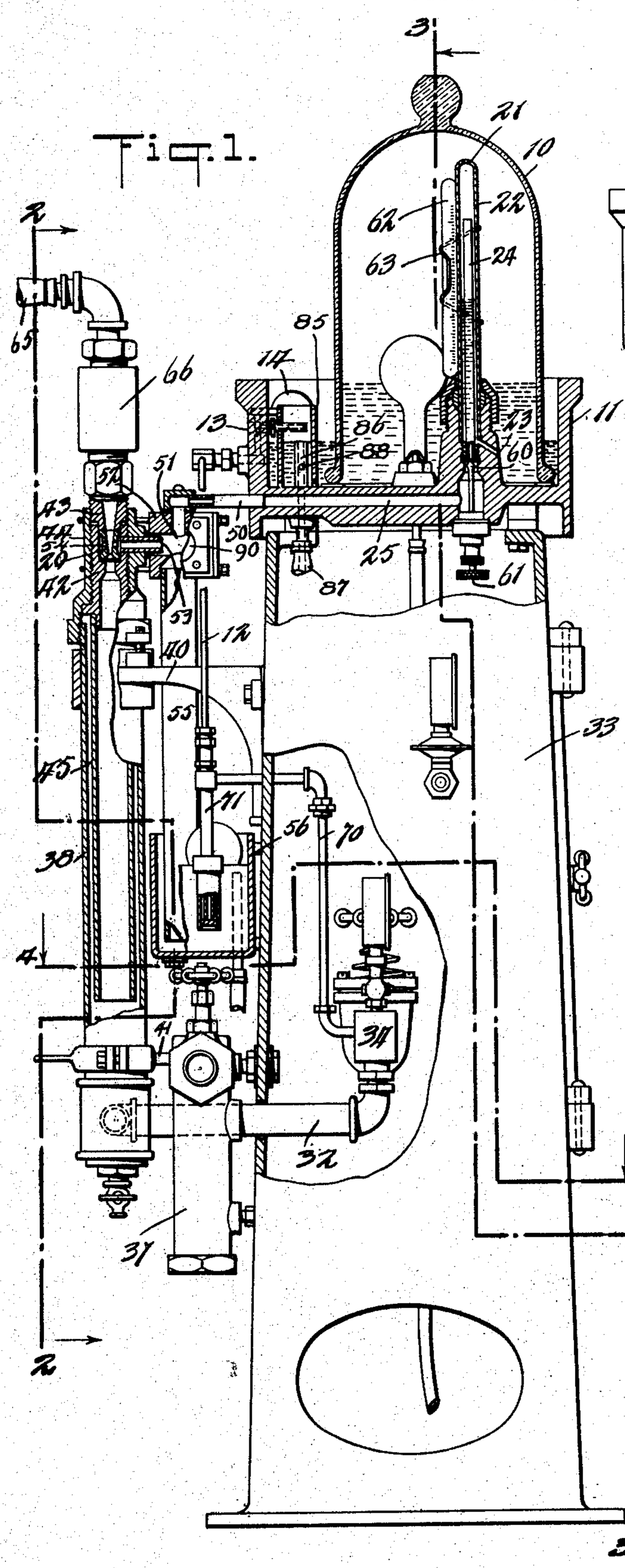
Oct. 7, 1930. C. F. WALLACE 1,777,986

GAS SUPPLY APPARATUS

Filed Nov. 30, 1927 2 Sheets-Sheet 1

Fig. 1.



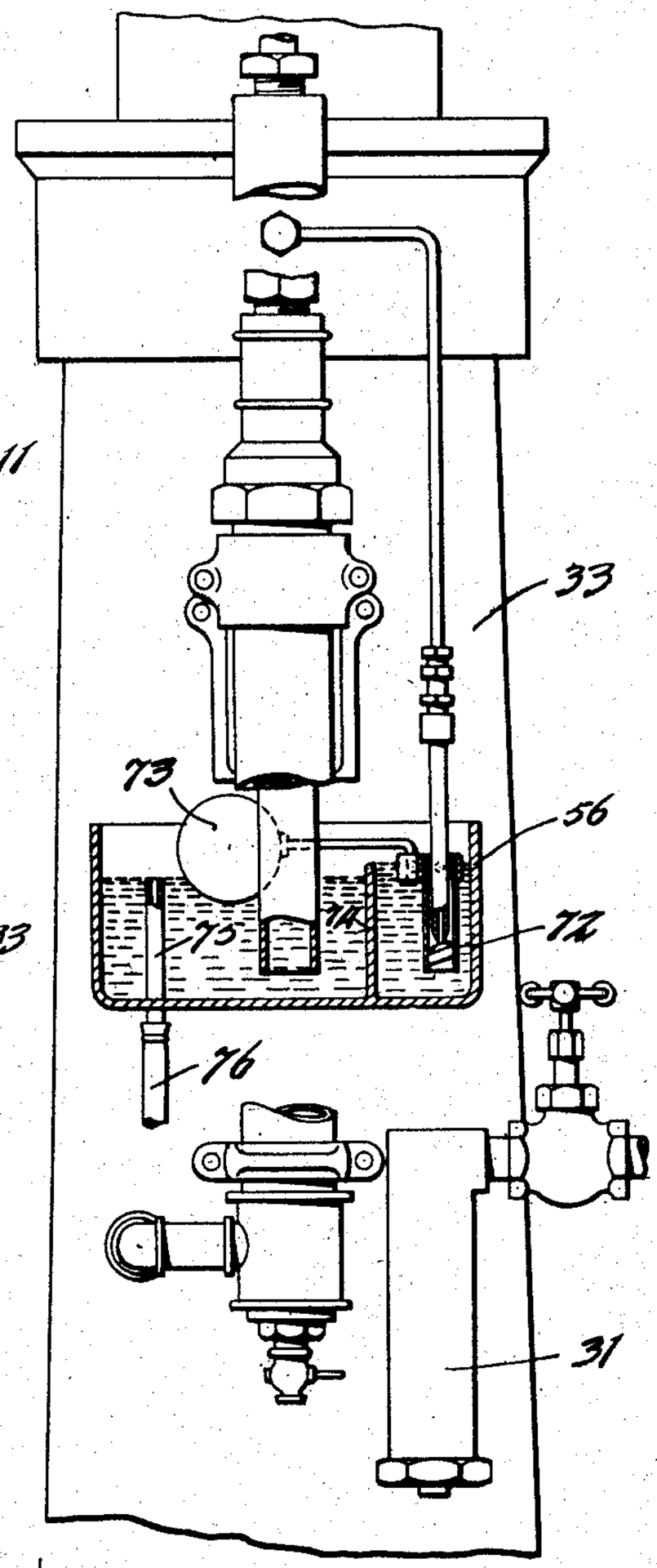


Fig. 2.

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GAS SUPPLY APPARATUS

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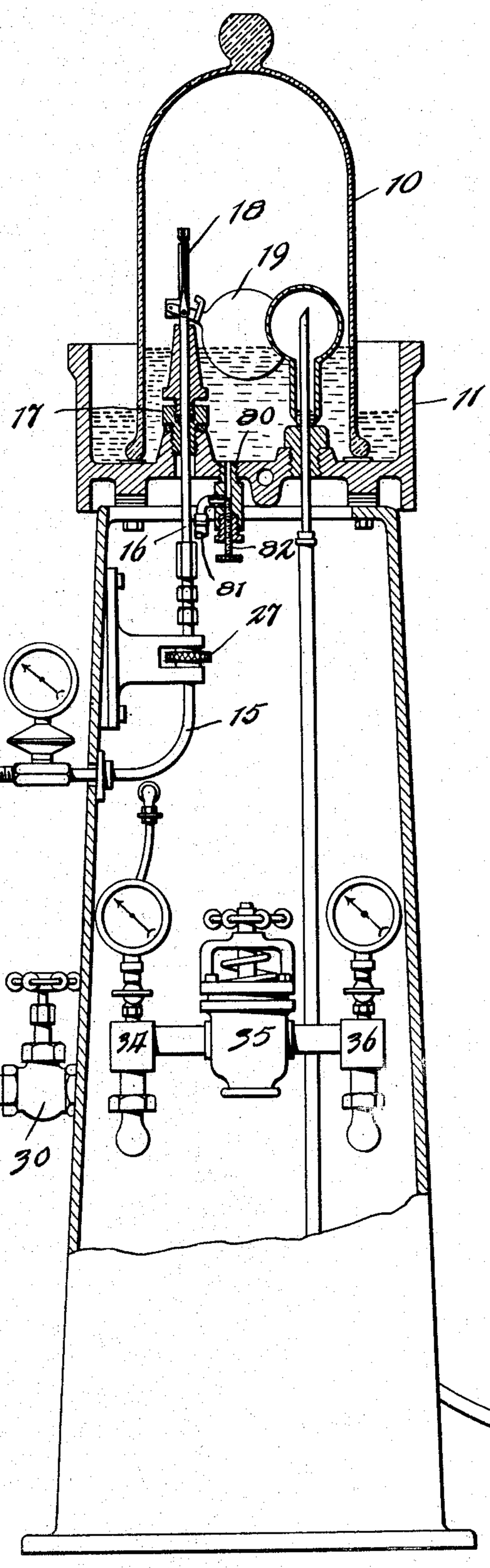


Fig. 3.

Fig. 4.

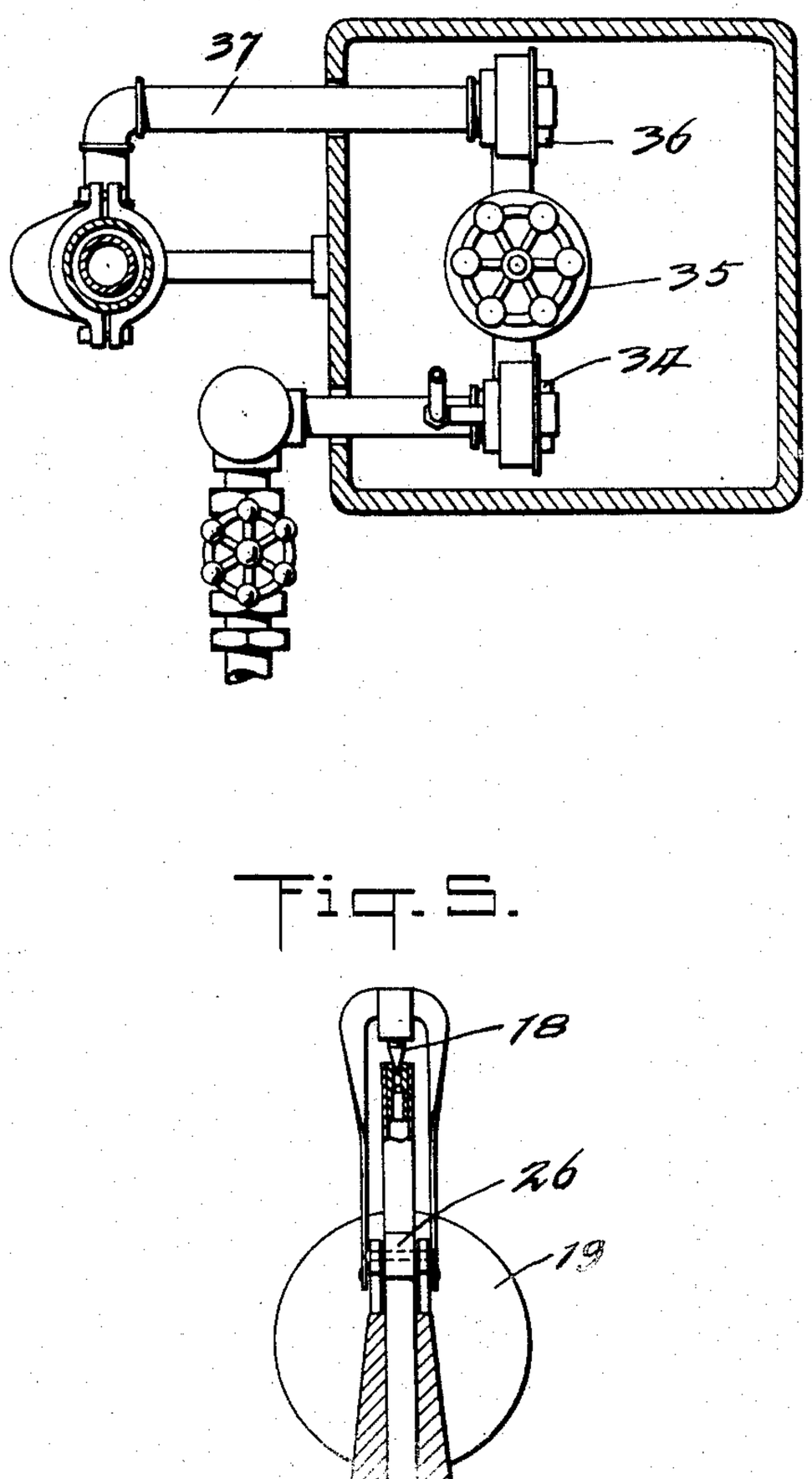
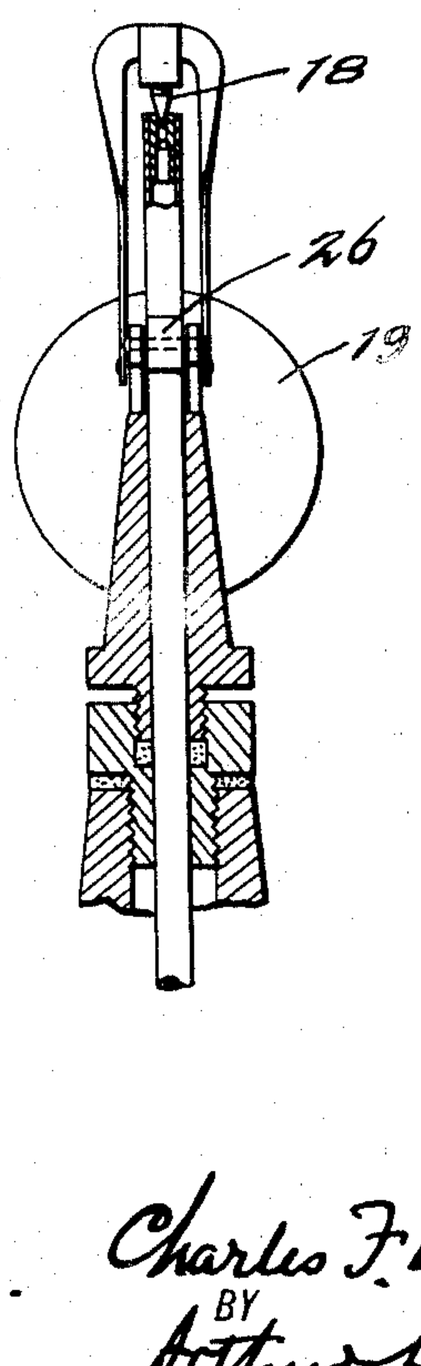


Fig. 5.



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UNITED STATES PATENT OFFICE

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GAS-SUPPLY APPARATUS

Application filed November 30, 1927. Serial No. 236,851.

This invention relates to gas supply apparatus for supplying a gas at a controlled rate which is not affected by the pressure of the source of supply of the gas, and the object of the invention is to provide an improved apparatus of this kind. The invention has been made especially with the idea of providing an improved apparatus for withdrawing chlorine from a container holding a supply of chlorine under pressure, and for supplying the chlorine gas for the treatment of water, such as the water of city or town supplies or sewage or other watery liquids, at a controlled and measured rate which may readily be varied as desired. The present invention is an improvement on the apparatus described and claimed in United States Patent No. 1,514,939 dated November 11, 1924, although features of the present invention may be employed in apparatus differing widely from the apparatus shown in said patent. The invention aims especially to avoid difficulties resulting from the formation of chlorine-hydrate in the apparatus, and to provide an apparatus which is accurate and reliable in operation, is of rugged construction, and the parts of which are conveniently accessible.

Apparatus embodying the invention in the form now considered most desirable comprises means for supplying gaseous chlorine or other treating gas drawn from a source of supply under pressure to a flow-controlling orifice of a flow meter at a constant substantially atmospheric pressure, a water aspirator or other suction device for drawing the gas through the flow-controlling orifice and mixing it with water, means for determining the suction head on the suction side of the aspirator by the negative head of a column of water raised by the aspirator and discharging to the aspirator throat, and means providing a flow resistance for reducing the suction head transmitted to the orifice of the flow meter which is adjustable for varying the rate of flow of the gas.

A full understanding of the invention can best be given by a detailed description of an approved chlorinating apparatus embodying the various features of the invention in connection with drawings illustrating such an apparatus, and such a description will now be given in connection with the drawings forming part of this specification, in which:

Fig. 1 is a sectional view of the apparatus showing certain parts in elevation;

Fig. 2 is a view looking from the left of Fig. 1 and partly in section on line 2—2 of Fig. 1;

Fig. 3 is a view taken on the line 3—3 of Fig. 1;

Fig. 4 is a view taken on line 4—4 of Fig. 1; and

Fig. 5 is a detailed view partly in section showing the chlorine reducing and control valve.

Referring to the drawings, 10 represents a bell jar which stands open end down in a tray 11 and provides a chlorine supply chamber in which, when the apparatus is in operation, a supply of chlorine gas is maintained under a constant substantially atmospheric pressure. Most desirably, the chlorine is maintained at a slightly negative pressure. Water is supplied to the tray 11 through a pipe 12 and is maintained at a constant level in the tray by a suitable means, such as the valve 13 controlled by a ball float 14, and the bell jar is supported so as to provide for passage of water into the jar beneath its lower edge. Chlorine gas is supplied to the chamber within the bell jar from a suitable source of supply under pressure, such as a tank of compressed liquified chlorine. For supplying the gas to the chlorine chamber, a chlorine supply tube 15 is provided to which connection is made from the source of supply and from which a tube 16 leads upward through the bottom of the tray 11 and through a stuffing box 17 to a point above the maximum water level within the bell jar. The supply of chlorine to the chamber is controlled by means of a valve 18 adapted to seat in a valve seat provided at the upper end of the tube 16 and operated by a ball float 19. Chlorine gas is drawn from the supply chamber by means of a suction device formed by a water aspirator 20 which draws the gas through a flow controlling orifice 21 formed in the top of a flow meter tube 22 which extends upward within the bell jar from the

bottom of the tray. A port 23 connects from below the water level in the supply chamber to the bottom of the tube 22, and a gas tube 24 connects to a passage 25 leading to the aspirator and extends upward within the tube 22 with its open upper end above the maximum level to which water rises in the tube 22 under the suction head established therein by the aspirator 20.

When the apparatus is in operation, the suction of the aspirator establishes a partial vacuum, or negative pressure, within the tube 22 causing the chlorine gas to flow from the supply chamber through the orifice 21. This tends to reduce the pressure within the supply chamber. Pressure reduction within the supply chamber causes the water to rise within the chamber, and when the water level within the chamber has risen sufficiently to slightly lift the float 19, the chlorine valve 18 is opened to permit chlorine gas to flow into the chamber and prevent further reduction of the pressure in the chamber. If the chlorine gas should flow into the chamber at a rate faster than it is being drawn from the chamber through the orifice 21, the increased pressure within the chamber would cause the water level within the chamber to drop, permitting the float 19 to drop and close the valve 18, thus shutting off the supply of chlorine gas to the chamber until the reduction of pressure within the chamber again resulted in the rise of the water level causing the float to open the valve. The means for controlling the inflow of chlorine to the chamber, that is, the pressure reducing valve 18 controlled by the float 19, thus acts to maintain the desired slight negative pressure within the chamber whatever the rate at which the gas is drawn from the chamber through the orifice 21. The degree of negative pressure, or partial vacuum, maintained within the chamber, and the operating water level within the chamber, depend on the position of the float 19 at which the valve 18 is closed. The float is carried by a lever pivoted to a lug 26 extending from the pipe 16, so that by moving the pipe slightly upward or downward through the stuffing box 17, as by means of an adjusting nut 27, the float may be raised or lowered to adjust the operating water level within the chamber and the negative pressure maintained within the chamber for the purpose of obtaining correct reading on the meter scale.

Water for supplying the aspirator 20 enters the apparatus through a shut-off valve 30 from which it passes through a strainer 31 and then, by pipe 32 which extends through the wall of the pedestal 33, to a connecting block 34, and thence through a pressure reducing valve 35, from which the water at the desired pressure determined by adjustment of the valve passes to a connecting block 36, and thence by pipe 37 extending out through the wall of the pedestal to the bottom of an aspirator supporting pipe 38. The aspirator supporting pipe 38 is supported in vertical position by brackets 40 and 41 extending from the pedestal 33.

The aspirator 20 is formed by a small Venturi tube seated within a tubular fitting 42 and held in place by a tubular fitting 43 the bore of which forms part of the expanding pressure-building discharge passage of the aspirator. The tubular fittings 42 and 43 are externally threaded and screwed into a casing member 44 which is mounted on the upper end of the supporting pipe 38. An inner tube 45 extends from the lower end of the fitting 42 downward within the supporting pipe 38, this tube being made of hard rubber or other suitable chlorine resistant material and serving to provide a diffusion chamber which is of sufficient depth to prevent access of chlorine water to the supply line when the apparatus is shut down.

The chlorine gas from the supply chamber within the bell jar 10 passing through the flow-controlling orifice 21 into the meter tube 22 flows thence downward through the inner meter tube 24 and through the passage 25 formed in the bottom of the tray 11 and thence by connecting pipe 50 to a suction chamber 51 formed within a block 52. From the suction chamber, the gas passes through a short horizontal tube 53 to a closed space surrounding the throat of the aspirator from which it enters the aspirator throat through a series of inlet openings 54 located just beyond the critical cross-section of the throat.

A water column tube 55 extends downward from the block 52, the upper end of this tube being open to the chamber 51 and the lower end being open and extending down below the water level of a constant level tray 56. Under the action of the aspirator, water is lifted in the tube 55, and the suction head in the suction chamber 51 is thus controlled and determined by the negative head of the column of water which is raised in the tube, excess capacity of the aspirator being satisfied by water drawn through the suction tube 53. The capacity of the aspirator must be sufficiently great compared to the size of the orifice 21 to maintain a partial vacuum or negative pressure in the suction chamber 51 sufficient to raise the water in the tube 55 up to the level of the suction passage 53. This being so, the maximum degree of vacuum which can be produced by the aspirator will be that equal to the negative head measured from the water level in the constant level box 56 to about the center line of the suction passage 53. This passage 53 is desirably made short and as small as possible consistent with the necessary flow capacity, so as to avoid its becoming clogged by chlorine hydrate.

A constant suction head will thus be maintained on the suction side of the aspirator tending to draw chlorine gas from the supply chamber through the orifice 21. In order to provide for adjusting the rate of supply of the chlorine gas, provision is made for adjustably varying the suction head transmitted from the suction chamber to the chlorine orifice 21 by means of an adjustable resistance in the gas flow line. For this purpose, in the construction shown, an adjustable restriction is provided by means of a valve 60 at the lower end of the tube 24 which is adjustable by means of a handle 61 beneath tray 11. This chlorine rate-of-flow valve, according to its setting, determines the suction head transmitted to the flow-controlling orifice 21, thus determining the rate of flow of chlorine from the supply chamber to the aspirator. Water will rise within the meter tube to a height corresponding to the degree of vacuum, or suction head, therein, and the water elevation in the meter tube above the level in the chamber 10 will indicate the drop in pressure across the orifice 21, so that, the meter tube being provided with a proper scale according to the size of the orifice, the height of the column of water in the tube will indicate the rate of flow of the chlorine gas, either directly if the tube is provided with a rate-of-flow scale, or indirectly if the tube is provided with a scale marked to show the negative pressure, or suction head.

In the construction shown, the meter scale is provided by means of a sealed tube 62 which is held against the meter tube, as by means of a spring clip 63, and which contains a strip of paper or other suitable material on which a scale is marked. An easily readable scale, not affected by the chlorine within the chamber, is thus conveniently and cheaply provided, and the scale is readily adjustable to bring its zero mark to the water level to be maintained within the chamber. The scale should be so adjusted, since the rate of flow of chlorine from the chamber depends upon the difference in pressure across the orifice, and this difference in pressure is measured by the height of the column of water within the tube 22 above the level of water within the chamber 10. A flow meter having a scale as above described is claimed in my divisional application filed June 3rd, 1930, Serial No. 459,030.

The chlorine gas, entering the aspirator throat through the inlet openings 54, goes quickly into solution in the water flowing through the aspirator and the chlorine solution thus formed passes through a discharge pipe 65 which leads to the point of application of the solution to the water to be treated, or other place of use. A check valve, the casing 66 of which is shown, may be provided just beyond the aspirator when the solution is to be discharged into a closed water line or otherwise against pressure.

As stated, the pressure at which the water is supplied to the aspirator depends upon the adjustment of the pressure reducing valve 35, and this pressure will be adjusted according to the pressure against which the chlorine solution is to be discharged. Where the solution discharge line extends downward for a considerable distance, the reduced water pressure required for supplying the aspirator may be less than the pressure desirable for supplying the constant level trays. Water for supplying the trays is, therefore, in the apparatus shown, taken off from the high pressure side of the valve. As shown, a supply pipe 70 leads from the connecting block 34 and is connected to the pipe 12 by which water is supplied to the tray 11. A branch pipe 71 also leads from the pipe 70 to supply the tray 56. The supply of water to the tray 56 is controlled by means of a valve 72 operated by a ball float 73. The tray is divided by means of a partition 74 into two compartments, one serving as the constant level compartment for supplying water to the tube 55 leading to the injector suction chamber, and the water from the supply pipe 71 being discharged into the other smaller compartment. Water flows from the smaller compartment into the larger compartment over the partition 74, and the water level in the larger compartment is always maintained below the level of the top of the partition. This insures against the possibility of any chlorine water coming in contact with the inlet valve 72. To insure against water rising above the desired level in the larger compartment of the tray, an overflow tube 75 is provided to which a waste tube 76 is connected.

One of the objects of the present invention is to eliminate difficulty from the formation of chlorine-hydrate. With this object in view, the apparatus has been arranged so that no water is drawn by the aspirator from the chlorine supply chamber within the bell jar 10, and the chlorine gas flows as a gas unmixed with water through the fixed inner tube of the flow meter and to the suction chamber, the gas and water being first mixed as they enter the short suction passage 53 leading to the aspirator throat. Difficulties from the presence of chlorine hydrate in the passages leading to the aspirator are thus avoided, and also hydrate difficulties which result from any considerable flow of water from the tray 11 outside of the bell jar to the inside of the bell jar. Having the gas flow unmixed with water to the suction chamber adjacent the aspirator throat also has the advantage of eliminating meter error due to the friction of flowing water.

In the absence of any flow of water from

the tray outside the bell jar into the bell jar to mix with the gas drawn out by the aspirator, it becomes necessary to guard against the presence of chlorine in the water in the tray outside the bell jar due to diffusion from the bell jar outward. For this purpose, an outlet passage 80 is provided leading from the chlorine chamber within the bell jar through the bottom of the tray to a waste pipe 81. This passage is controlled by a circulation valve 82 which is adjusted so as to permit a very slight flow of water through the outlet 80, just enough to cause a flow of water into the bell jar sufficient to prevent any objectionable presence of chlorine in the body of water in the tray outside the bell jar.

In order to further reduce the tendency of chlorine hydrate to build up in the water in the tray inside the bell jar, by reducing the cooling of the water inside the bell jar by the water outside the bell jar, a cup 85 is provided in the tray outside the bell jar into which the water from the supply valve 13 is discharged and from which an overflow tube 86 having a bleeder hole 88 leads to a waste discharge tube 87. The bottom of the cup is formed to permit passage of water, so that the proper water level is maintained in the tray without eddy currents being set up in the tray outside the bell jar.

The suction chamber 51 is desirably provided with a sight glass 90 to permit the operator to see into the suction chamber at the level of the suction passage for observing whether or not the machine is operating properly. When properly operating, the water will stand at the level of the suction passage 53 to be pulled into the aspirator through suction passage 53 along with the gas.

Parts of the apparatus with which chlorine may come in contact will, of course, be made of suitable chlorine resistant material.

The operation of the apparatus as a whole will be understood from the foregoing description. If the apparatus is to operate with the gas maintained at a slightly positive pressure within the bell jar, then the operating water level within the bell jar will be below the water level in the tray outside the jar, and if the supply of gas in the bell jar is to be maintained at atmospheric pressure, the operating water level within the jar will be the same as the water level in the tray. Most desirably, however, as before stated, the gas is maintained at a slightly negative pressure in the bell jar.

It is to be understood that the invention is not limited to the exact construction shown and to which the foregoing description has been largely confined, but that it includes changes and modifications within the claims, and that features of the invention as claimed may be used independently of other features thereof.

What is claimed is:

1. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant substantially atmospheric pressure, a suction device connected to a passage leading from the orifice, means for determining the negative pressure on the suction side of the suction device by the negative head of a column of liquid raised by the suction of the suction device, and means providing an adjustable flow resistance for varying the suction head transmitted to the discharge side of the orifice.

2. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant substantially atmospheric pressure, a suction device connected to a passage leading from the orifice, means for maintaining a constant negative pressure on the suction side of the suction device determined by the negative head of a column of liquid raised by the suction device, and means providing an adjustable restriction for varying the suction head transmitted to the discharge side of the orifice.

3. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant substantially atmospheric pressure, a suction device connected to a passage leading from the orifice, means for maintaining a constant negative pressure on the suction side of the suction device, and means providing an adjustable resistance for varying the suction head transmitted to the discharge side of the orifice.

4. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant substantially atmospheric pressure, a water aspirator, means providing a suction chamber and a water column tube extending downward from the suction chamber, a gas passage leading from the orifice to the suction chamber, a short suction passage leading from the suction chamber to the aspirator throat through which water and gas pass to the aspirator, and means providing an adjustable resistance for varying the suction transmitted through said gas passages to the discharge side of the orifice.

5. Apparatus for supplying a treating gas, comprising a flow meter having a flow-controlling orifice, means for supplying gas to the intake side of the said orifice at a constant substantially atmospheric pressure, a water aspirator, means for determining the negative pressure on the suction side of the aspirator by the negative head of a column of

water raised by the aspirator and discharging into the aspirator throat, said means comprising a suction chamber and a water-column tube extending downward from the suction chamber and a suction passage leading from the suction chamber, and a gas passage leading from the flow meter to said suction chamber.

6. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant substantially atmospheric pressure, a water aspirator, means for maintaining a constant negative pressure on the suction side of the aspirator comprising a water column tube connected to the aspirator throat by a passage the intake end of which is at a distance above the normal water level of the tube corresponding to the desired suction head and having a gas inlet, and a passage leading from the orifice to said gas inlet, and means for varying the suction head transmitted from said water column tube to the orifice.

7. Apparatus for supplying a treating gas, comprising a flow meter having a flow-controlling orifice, means for supplying the gas to the intake side of said orifice at a constant substantially atmospheric pressure, a suction device, a gas passage leading from the flow meter to the suction device, means for maintaining a constant negative pressure on the suction side of the suction device, and means providing an adjustable restriction for varying the suction head transmitted to the meter orifice.

8. Apparatus for supplying a treating gas, comprising a flow meter having a flow-controlling orifice, means for supplying the gas to the intake side of said orifice at a constant substantially atmospheric pressure, a suction device, a gas passage for the flow of gas only leading from the flow meter and connected to the suction device, and means for maintaining a constant negative pressure on the suction side of the suction device.

9. Apparatus for supplying chlorine, comprising a chamber in which a supply of chlorine is maintained at a slightly negative pressure, and means for drawing chlorine from said chamber at a measured rate comprising a water aspirator, means for maintaining a constant negative pressure on the suction side of the aspirator, a flow meter connected between the aspirator and the chlorine chamber and communicating with the chlorine chamber through a flow-controlling orifice, and adjustable means between the flow meter and the aspirator for reducing the suction head transmitted to the orifice of the flow meter.

10. Apparatus for supplying chlorine, comprising a chamber in which a supply of chlorine is maintained at a slightly negative pressure, and means for drawing chlorine from said chamber at a measured rate comprising a water aspirator, means for maintaining a constant negative pressure on the suction side of the aspirator, a flow meter communicating with the chlorine chamber through a flow-controlling orifice, and a gas passage for the flow of gas only leading from the flow meter and connecting to the aspirator.

11. Apparatus for supplying a treating gas, comprising a flow meter having a flow-controlling orifice, means for supplying the gas to the intake side of said orifice at a constant pressure, a gas supply passage leading from the meter, means for maintaining a flow of water, a gas chamber to which said gas passage leads and from which the gas passes into said flow of water, and means for maintaining a constant pressure in said gas chamber less than the pressure at which the gas is supplied to the meter orifice.

12. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant pressure, a gas supply passage leading from the orifice, means for maintaining at a place in said gas supply passage removed from the orifice a constant pressure less than the pressure at which the gas is supplied to the orifice, and means providing an adjustable resistance between said place of constant pressure and the orifice for determining the pressure drop across the orifice.

13. Apparatus for supplying a treating gas, comprising a gas chamber extending upward from a constant level water-holding tray from which water has access to the interior of the chamber means for supplying gas to said chamber, means responsive to variations in the level of water within the chamber for controlling the supply of gas to the chamber to maintain a constant substantially atmospheric pressure therein, a water aspirator for withdrawing gas from the chamber, means for maintaining a constant negative pressure on the suction side of the aspirator, a flow meter comprising a water column tube extending upward within the chamber and communicating with the gas space in the gas chamber through a flow-controlling orifice above the maximum water level in the tube and having a gas outlet above said maximum water level, a passage leading from the outlet of said meter tube to the aspirator, and means providing an adjustable restriction for reducing the suction head transmitted to the meter orifice.

14. Apparatus for supplying a treating gas, comprising a gas chamber extending upward from a constant level water-holding tray from which water has access to the interior of the chamber, means for supplying gas to said chamber, means responsive to vari-

ations in the level of water within the chamber for controlling the supply of gas to the chamber to maintain a constant substantially atmospheric pressure therein, a water aspirator for withdrawing gas from the chamber, means for determining the negative pressure on the suction side of the aspirator by the negative head of a column of water raised by the aspirator and discharging into the aspirator throat, a flow meter comprising a water column tube extending upward within the chamber and communicating with the gas space in the gas chamber through a flow-controlling orifice above the maximum water level in the tube, and a gas passage leading to the aspirator including a fixed tube extending upward within the meter tube to a point above the maximum water level therein.

15. Apparatus for supplying a treating gas, comprising a gas chamber, means for supplying gas to said chamber, means for controlling the supply of gas to the chamber to maintain a constant substantially atmospheric pressure therein, a flow meter comprising a liquid column tube connected with the gas chamber through a flow-controlling orifice and having a gas outlet above the maximum liquid level in the tube, a water aspirator, a gas passage leading from the outlet of the meter tube to the aspirator, and means providing an adjustable resistance for varying the suction head transmitted to the flow-controlling orifices.

16. Apparatus for supplying a treating gas, comprising means providing a gas chamber extending upward from a constant level water-holding tray from which water has access to the interior of the chamber, means for supplying gas to said chamber, means for controlling the supply of gas to the chamber to maintain a constant substantially atmospheric pressure therein, a gas passage leading from the chamber and connected thereto through a flow-controlling orifice, a suction device for drawing gas through said passage, and a continuously open water outlet from the water space within the chamber for maintaining a slight flow of water into the chamber from the space in the tray outside the chamber.

17. Apparatus for supplying a treating gas, comprising means providing a gas chamber extending upward from a constant level water-holding tray from which water has access to the interior of the chamber, means for supplying gas to said chamber, means for controlling the supply of gas to the chamber to maintain a constant substantially atmospheric pressure therein, a gas passage leading from the chamber and connected thereto through a flow-controlling orifice, a suction device for drawing gas through said passage, a water outlet from the water space within the chamber for maintaining a slight flow of water into the chamber from the space in the tray outside the chamber, a partition in the tray outside the chamber extending above the water level in the tray and forming a small compartment into which the water flows for supplying the tray, said partition having an opening below the water level of the tray for the passage of water from the small chamber into the tray, and an overflow outlet leading from said small compartment.

18. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant substantially atmospheric pressure, a water aspirator, means for maintaining a constant negative pressure on the suction side of the aspirator comprising a water-column tube connected by a suction passage to the aspirator throat and having a gas inlet, a constant level box for supplying water to the water-column tube, said box having a partition dividing the box into two compartments, a valve-controlled water supply inlet discharging into one of said compartments, a float in the other compartment for controlling said valve to maintain the water level in the float compartment below the top of said partition, the lower end of the water-column tube being submerged in the float compartment, and a passage leading from the flow-controlling orifice to the gas inlet of the water-column tube.

19. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means for supplying the gas to the intake side of the orifice at a constant pressure, a water aspirator, means for maintaining a constant pressure on the suction side of the aspirator less than the pressure at which the gas is supplied to the flow-controlling orifice comprising a water-column tube connected by a suction passage to the aspirator throat and having a gas inlet, a constant level box for supplying water to the water-column tube, said box having a partition dividing the box into two compartments, a valve-controlled water supply inlet discharging into one of said compartments, a float in the other compartment for controlling said valve to maintain the water level in the float compartment below the top of said partition, the water-column tube receiving its water from the float compartment, and a passage leading from the flow-controlling orifice to the gas inlet of the water-column tube.

20. Apparatus for supplying a treating gas, comprising means providing a flow-controlling orifice, means including a pressure reducing valve for supplying the gas to the intake side of said orifice at a constant pressure, a gas supply passage for the flow of gas only leading from the orifice, a suction chamber to which said gas passage leads, a water aspirator for withdrawing the gas

from said chamber into a flow of water, and means communicating with said chamber for maintaining a constant pressure therein less than the pressure at which the gas is supplied to the flow-controlling orifice.

In testimony whereof I have hereunto set my hand.

CHARLES F. WALLACE.