(No Model.)

J. SCHNEIBLE.

METHOD OF CHARGING LIQUIDS WITH GAS.

No. 538,086. Patented Apr. 23, 1895.

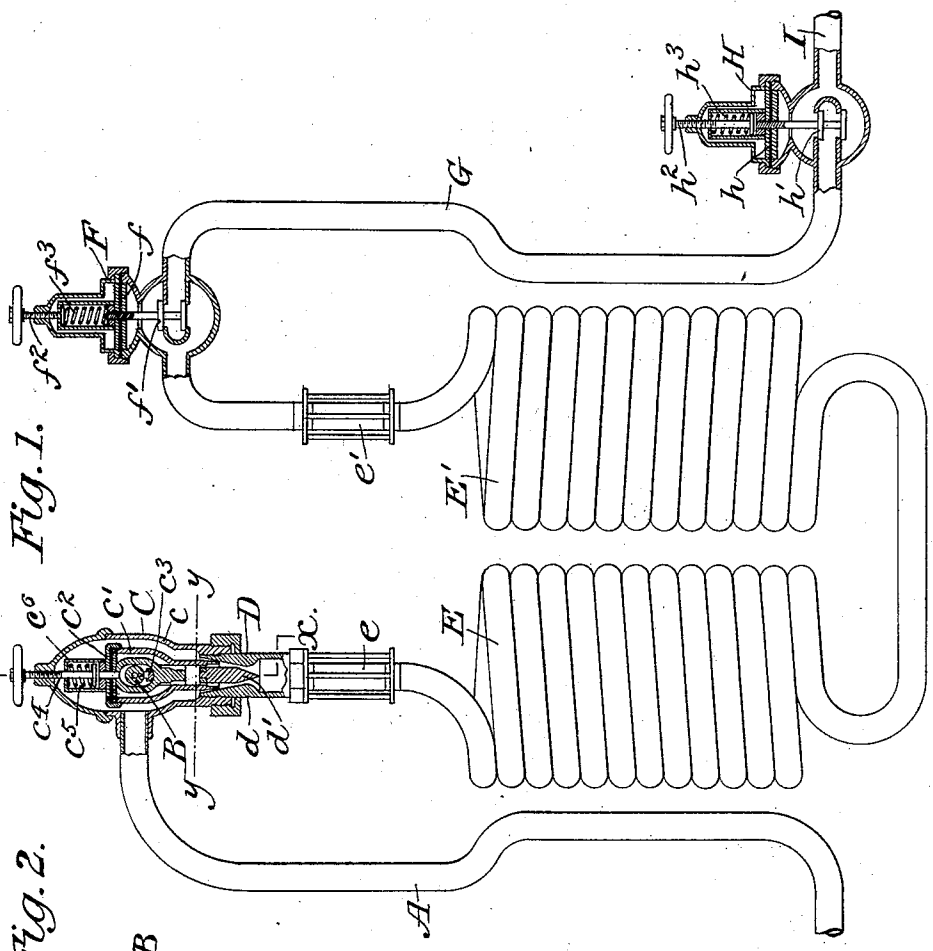


Fig. 1.

Fig. 2.

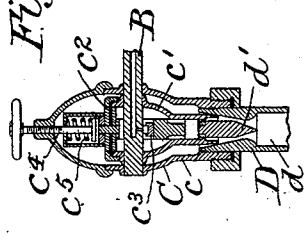
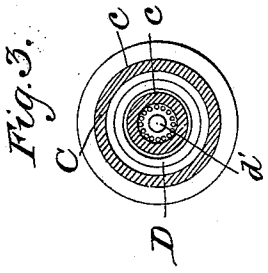


Fig. 3.



Attest:
D. Peb. Palmedo
A. N. Jesbera.

Inventor:
Joseph Schneible
by William B. Greeley
Atty.

UNITED STATES PATENT OFFICE.

JOSEPH SCHNEIBLE, OF BROOKLYN, NEW YORK.

METHOD OF CHARGING LIQUIDS WITH GAS.

SPECIFICATION forming part of Letters Patent No. 538,086, dated April 23, 1895.

Application filed December 4, 1893. Serial No. 492,783. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH SCHNEIBLE, of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Methods of Charging Liquids with Gas; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making a part of this specification.

Prior to the date of the invention for which Letters Patent of the United States No. 474,413 were granted various methods of charging liquids with gas on the run had been tried and submitted to the test of actual use with varying but generally indifferent success. Generally speaking the gas used had been supplied under a greater pressure than that under which the liquid was supplied, it being deemed essential, apparently, that the gas, being of relatively smaller density, should be injected into the liquid. By the long continued experiments and practical tests which led up to the invention referred to it was found that better results than were theretofore possible could be secured by supplying both the liquid and the gas under substantially equal pressures. The method which was based upon this discovery was found to be productive of good results when the prescribed conditions could be maintained, but through the experience gained by the continued operation of the method it has been found that further advantages follow from a further change from the old methods which were in vogue before the date alluded to and from that set forth in said Letters Patent—that is to say, whereas such old methods required the supply of gas under a pressure greater than that on the liquid, and whereas in accordance with the improved method described in said patent, the pressure on the gas was reduced until it was substantially equal to that on the liquid, the new method which is the basis of the present invention involves the supplying of gas under a less pressure than that upon the liquid and the mingling of the gas with the flowing liquid. The practice of this method, particularly when there is maintained on the mingled gas and liquid a pressure higher than that on the gas at the point of mingling, permits a greater uniformity in the character of the finished product to be secured, enables the quantity of gas introduced into the liquid to be varied as required, renders the operation of the method less liable to be interrupted and makes the constant supervision by an attendant less necessary.

I will proceed to describe the improved method more at length hereinafter, setting forth also other steps which may be adopted in practice in conjunction with that referred to above and are desirable for the attainment of the best results.

In the accompanying drawings, Figure 1 represents, partly in outline and partly in section, the main features of one form of apparatus which is adapted for the practice of the improved method. Fig. 2 is a section on the line *x*—*x* of Fig. 1, illustrating more clearly a portion of the apparatus referred to hereinafter. Fig. 3 is a transverse section on the line *y*—*y* of Fig. 1, on a larger scale, to show somewhat more clearly the arrangement of the aspirator.

It will be understood that although a certain form of apparatus has been selected for illustration, the method sought to be covered is independent of any and all particular form of apparatus and that my present invention is not restricted except as may be indicated in the claims.

The apparatus which has been chosen for illustration of the principle of this invention comprises a conductor A through which the liquid is supplied under pressure from a pump or by gravity, a conductor B through which the gas is supplied from any source, a regulating device, indicated at C, which would be used in the form shown or in some other form when the gas is supplied under pressure, for the purpose of causing variations of pressure on the liquid to produce corresponding variations in the pressure on the gas admitted for introduction into the liquid, an aspirator or other device indicated at D through which the liquid is forced and draws the gas onward and mingles it with itself, an absorption chamber or vessel which may be in the form of one or more coils E, E′, of tubing in which observation glasses *e*, *e′* are set, a regulating valve

or other device, indicated at F, for maintaining automatically more or less pressure upon the liquid after the gas has been introduced into the same, and a discharge pipe G which may be equipped with a regulating valve or device, indicated at H, for automatically checking the operation of charging should the pressure in the vessel to which the charged liquid may be conducted rise above a predetermined degree.

In order that the method may be readily understood I will proceed to describe the construction of the regulating devices C, F and H and of the aspirator D which are represented in the drawings, although it will be understood that the invention is not in anywise restricted thereby.

The regulating device C comprises an outer shell c inclosing a chamber to which liquid is admitted, an inner shell c' inclosing a chamber to which the gas is admitted, a movable diaphragm c^2 which separates the two chambers and is adapted to move as the pressure thereon varies, and a valve c^3 which is carried by said diaphragm and is adapted to control the admission of gas to the inner chamber. A rod c^4 and spring c^5 may also be provided for the purpose of influencing the action of the diaphragm at will and thereby varying the pressure at which the valve plug c^3 shall open or close to control the admission of gas to the inner chamber. The spring c^5 is compressed within a sleeve c^6, attached to the diaphragm, by the upward movement of the rod c^4 and serves particularly to compensate the over-pressure of the liquid on the upper side of the diaphragm and so to close the valve when the flow of liquid ceases.

The outer chamber of the regulator C communicates directly with the aspirator or jet pump D to which the gas is also conducted from the inner chamber. The aspirator or jet pump is of any suitable form which will cause the liquid, as it flows through the same, to exert suction upon the gas and then impel it onward, it being desirable, in order that the relative amount of gas admitted shall be always under control, that the gas shall not enter the aspirator except as it is made to enter by the liquid. In order that the power of the same may be varied readily according to the varying requirements of the work to be done it is pereferably provided with an inwardly tapering sleeve d which is longitudinally adjustable with respect to a central core d' or vice versa. Immediately below the line of greatest contraction the bore of the sleeve is enlarged to form a chamber which has an area in cross section considerably greater than the area in cross section of the orifice through which the liquid and gas are discharged into it, so that the area in cross section of the stream of liquid immediately after the gas is mingled therewith shall be in like proportion to the area in cross section of the stream of liquid at the point where the liquid and gas come in contact, whereby it becomes possible to maintain the flow of the gas and the mingling thereof with the liquid although the gas is under a lower pressure than that on the liquid and to a certain extent to measure and control the flow or quantity of the gas by that of the liquid.

The regulating device F comprises a diaphragm f which is adapted to move as the pressure thereon varies, a valve plug f' carried by said diaphragm and adapted to permit the escape of the charged liquid into the discharge pipe G only when the pressure thereon is sufficient to lift the diaphragm f, and a screw-threaded rod f^2 and spring f^3 by means of which the action of the diaphragm may be influenced.

The pressure regulating device H is similar in construction to the device F, but its diaphragm h is exposed to the back pressure in the pipe I, which may conduct the liquid to a receiving vessel, and the valve plug h' carried by it will be moved by any excess of such back pressure, above a predetermined degree, to prevent the escape of the charged liquid from the pipe G and to stop the operation. The degree of pressure at which the valve shall close may be regulated by a screw-threaded rod h^2 and spring h^3.

In the practice of the improved method, whether carried on in the apparatus represented or in any other form of apparatus the liquid to be charged is supplied under a pressure which may vary according to the requirements of each case. In order to obtain the best results as regards uniformity in the character of the finished product and to enable the practice of the method to be carried on with the greatest economy of time and attention it is desirable that the liquid should be supplied in a constant stream and under substantially uniform pressure, particularly in the use of the apparatus shown in which variation of pressure would cause variation of the action of the aspirator.

In the use of the apparatus shown, when the gas is supplied through the pipe B under more or less pressure, any material increase of pressure on the liquid will depress the diaphragm c^2 and will shift the valve plug c^3 to permit a proportionately greater flow of gas into the inner chamber to be drawn therefrom by the onward flow of the liquid. As the liquid passes on from the point where, in the apparatus shown, its pressure is made to determine the pressure of the gas in the inner chamber, it flows through the device at D and is caused to mingle with itself the gas from the inner chamber c' and to impel it onward with itself in its flow, in a finely divided state, into the absorption chamber in which there is maintained a pressure preferably greater than that under which the gas is supplied. The device indicated at C may act as a check-valve to prevent the back flow of the liquid into the gas conductor when the flow through the coils E, E', is stopped, for as the spring c^5 supports the diaphragm, in operation, against the over-pressure of the liquid on its upper

side, it is evident that when the pressure on the under side of the diaphragm approaches that on the upper side, which will be the case when the flow of liquid ceases, the spring will then immediately lift the diaphragm and close the valve.

The gas is conducted to the chamber *c'* through the pipe B from any suitable source of supply, as from a vessel in which it is stored under pressure, or directly from the point where it is generated or set free. In any case, however, its pressure, when it approaches the point where it is introduced into the liquid or brought in contact with the liquid, is less than the pressure on the liquid so that it shall not be injected into the body of the flowing liquid, but may rather be drawn on by and with the liquid in its onward passage. It is important that the gas shall not pass into the liquid under the influence of its own pressure independent of the action or influence of the liquid, for the reason that it would then be practically impossible to control the relative quantity of gas admitted for absorption with the certainty that is desirable. As the liquid and gas pass on together from the point where the two first come in contact the gas may be compressed to a certain extent by the impact of the denser particles of the liquid driven by greater pressure. This compression is increased when, as under the preferred conditions of operation, a pressure is maintained in the absorption chamber materially greater than that under which the gas is supplied. The thorough mingling of the gas with the impelling liquid takes place during the passage of the two immediately beyond the point where they first come in contact and the incorporation and absorption of the gas with and by the liquid are effected rapidly.

As already pointed out in describing the apparatus as shown in the drawings, it is desirable to provide for the variation of the aspirating power of the liquid, whether by the means referred to, that is to say, by varying the relative area in cross section of the stream of liquid at and after the point of contact of the stream of gas therewith, or by varying the back pressure, or in any other way, in order that the quantity of gas, relative to the quantity of liquid may be varied at will during the operation of charging, although other conditions are not changed.

In order that the absorption of the gas by the liquid may be more complete and permanent, it is desirable that some degree of pressure shall be maintained upon the mingled gas and liquid for a short time after incorporation has taken place. The degree of this pressure will be varied according to the necessities of each case and according to the characteristics of the gas and liquid separately considered and of the finished product, as will also the length of time during which the pressure is maintained.

In the apparatus represented in the drawings the degree of pressure is regulated automatically by the device represented at F, while the duration of the pressure is determined by the length and size of the intermediate vessel or tubing E, E'. As indicated above, it is desirable, for the most successful operation of the method and the production of uniform results, that this pressure on the newly charged liquid shall be materially greater than that under which the gas is supplied, thereby furthering the compression of the gas referred to and aiding in the control of the relative quantity of gas by preventing the entrance of gas except as it is caused to flow by the impelling liquid.

In some cases it may be desirable to deliver the charged liquid directly from the discharge pipe G into a closed receiving vessel and it is obvious that from a variety of causes the pressure in such a receiving vessel might rise to a point where it would interfere with and vary the conditions which had been fixed for the practice of the method. It is further desirable that any excessive rise of pressure whether occasioned in the manner suggested or by checking or by stopping the discharge should of itself automatically stop the further operation of charging. For this purpose a check valve, such as is represented in the drawings, or one of any other suitable form, may be provided, but however if the flow of the liquid from the discharge pipe is stopped it is evident that the stopping of the flow of liquid will also effect the stopping of the flow of gas for the reason that the gas is under less pressure than the liquid and passes into it only as it is drawn in and impelled by the flow of the liquid itself.

It will be understood that the only limitation which is intended to be implied herein, so far as the supply of gas is concerned, is that there shall not be a pressure thereon near the point of mingling of the gas and liquid as great as that upon the liquid at the corresponding point. Within this restriction the gas might be supplied under any degree of pressure, whether greater or less than atmospheric pressure, the movement of the gas in the latter case toward the point referred to being induced by the aspirating action of the stream of liquid.

I claim as my invention—

1. The method of charging liquids with gas which consists in supplying the liquid under pressure, supplying the gas under a lower pressure than that on the liquid, and causing the liquid as it flows to draw the gas with it and to effect the incorporation thereof with itself.

2. The method of charging liquids with gas which consists in supplying the liquid under pressure, supplying the gas under a lower pressure than that on the liquid, causing the liquid as it flows to draw the gas with it and to effect the incorporation thereof with itself, and maintaining pressure on the mingled gas and liquid while absorption is taking place.

3. The method of charging liquids with gas

which consists in supplying a stream of liquid under pressure, supplying the gas under a pressure less than that on the liquid, causing the liquid to mingle the gas with itself as it flows, permitting the stream of mingled gas and liquid immediately after the mingling to increase to an area in cross section considerably greater than the area in cross section of the stream of liquid at the point of contact of the gas therewith, and maintaining pressure on the mingled gas and liquid while absorption is taking place.

4. The method of charging liquids with gas which consists in supplying the liquid under pressure, supplying the gas under less pressure than that on the liquid, causing the liquid to mingle the gas with itself as it flows, and afterward maintaining on the mingled gas and liquid, while absorption is taking place, a pressure greater than that under which the gas is supplied, the gas being forced by and with the liquid against the greater pressure.

5. The method of charging liquids with gas which consists in supplying the liquid under pressure, supplying the gas under less pressuse than that on the liquid, causing the liquid to draw and impel the gas with it and to effect the mingling thereof with itself, and afterward maintaining on the mingled gas and liquid, while absorption is taking place, a pressure greater than that under which the gas is supplied, the gas being forced by and with the impelling liquid against the greater pressure.

6. The method of charging liquids with gas which consists in supplying the liquid under pressure, supplying the gas under a pressure lower than that on the liquid, causing the pressure on the liquid to control the supply of the gas whereby variations in the pressure on the liquid are accompanied by corresponding variations in the supply of the gas, and causing the liquid as it flows to draw the gas with it and to effect the incorporation thereof with itself.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH SCHNEIBLE.

Witnesses:
W. B. GREELEY,
A. N. JESBERA.