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See also the references under the title "Experimental."

DEPARTMENT OF ANALYTICAL CHEMISTRY,
UNIVERSITY OF WISCONSIN, MADISON.

A NITROGEN GENERATOR.

BY CHAS. VAN BRUNT.

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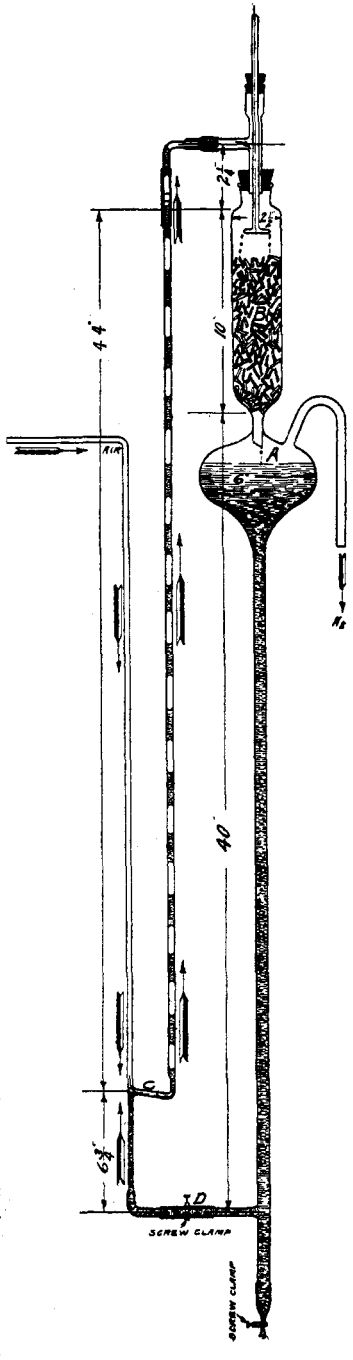
A form of generator for producing oxygen-free nitrogen from air, which has some advantages over those hitherto commonly used, has been devised by the writer and has been in constant use for over a year in this laboratory. The absorbing medium for oxygen is the well known copper-ammonium carbonate combination. What novelty there is consists in the continuous circulation of the solution through the copper column in the absorption vessel by means of an air-lift actuated by the incoming air current.

The nitrogen obtained by this means is so far free from oxygen that an incandescent tungsten wire is not oxidized even in a rapid current of the gas. Experience shows this to be a test of great delicacy. As a matter of security, however, it has been usual to add a tube of hot copper to the

system, but there has been so far no experience to prove that this is necessary, even for refined work.

The generators in use in this laboratory have the form and dimensions shown in the sketch herewith, the size of the reservoir A being varied to suit the capacity required. It is essential that the tube leading vertically downward from the bottom of the reservoir shall be long enough to give a pressure at the level of C, where the air meets the liquid, such that the volume of solution carried up may be at least equal to that of the accompanying air without danger of the latter backing up into A. The slight downward slope of the tube C is essential to the steady operation of the lift. The internal diameter of the riser tube should not exceed 5 or 6 mm. unless an unusually rapid current of gas is required. Adjustment of the relative proportions of air and solution is made by means of the screw clamp D. The best results are obtained when the rate of flow of the solution is such that it rises as nearly to the top of the opening into C as is possible without interrupting the down-coming air current at this point.



The air-liquid mixture is discharged over the adjustable glass bell in the top of B, which distributes the liquid over the top of the column of copper chips or clippings. Gas and liquid traverse this column together. The plentiful flow of solution washes the oxide film from the copper as fast as it is formed by the action of the incoming air, thus maintaining the surface in active condition. The result is complete deoxidation of the air, the reaction being vigorous enough to cause a noticeable rise in temperature when the current is rapid. The deoxidized air is delivered as shown, whence it passes through a purifying train

adapted to remove the vapor derived from the solvent. Dilute sulfuric acid is used to remove the ammonia. (The concentrated acid causes stoppage of the tubes, due to separation of solid ammonium sulfate.)

The solution collected in *A* carries, of course, the copper oxide formed by the wet combustion in *B*. A good deal of this dissolved copper is reduced to, or remains in, the univalent state in its passage through *B*, and the reducing energy thus stored is later effectively expended upon the incoming air in the lift.

The solution, as freshly charged to the apparatus, is made by adding to a saturated solution of the "Ammonium Carbonate" of commerce its own volume of ammonia of 0.93 sp. gr. One liter of such a solution may be depended upon for approximately 75 liters of nitrogen from air before becoming exhausted. The approach of this point is accompanied by a dulling of the luster of the copper not difficult to recognize, and also by a slight foaming of the solution. One or two experiments were made which tended to show that equally good results could be obtained by substituting ammonium chloride for the carbonate, maintaining the same molal concentrations of total NH_3 and of the acid radical in each case, namely, about 8 and 2 per liter, respectively, but this has not been tried out in practice.

If the air supply is provided with a safety or reducing valve, the pressure may be left on the apparatus and the nitrogen current started, stopped and regulated by a cock on the delivery tube. The tendency of the air to back out through the reservoir on sudden starting is easily guarded against by a little care; or a check valve may be provided or a downward extension of the tubing if the added vertical extension of the system is not objected to.

In place of air, the oxygen-contaminated nitrogen commonly supplied in pressure tanks has been much used in this laboratory. Of course the life of a charge of solution and copper is greatly extended by this plan.

It may be suggested that the principle of the air-lift as exemplified in the above described device is a laboratory aid which has not had the attention it deserves. That it has other useful applications than the one described is manifest. In designing and adjusting apparatus embodying the principle, it is necessary only to remember that the hydrostatic pressure of the liquid in the reservoir should overbalance that of the column of mixed gas and liquid in the riser by an amount equivalent to the required "velocity head."

RESEARCH LABORATORY OF THE GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.

NOTE.

Panel for Electro-analysis.—The electrolytic panel, described below, embodies a number of shop kinks which may be of interest to chemists. The