LIST OF LOCOMOTIVE ENGINES BUILT BY MESSRS. EDWARD BURY & CO., OF THE CLARENCE FOUNDRY, LIVERPOOL, AND SENT TO AMERICAN RAILROADS.

Date when Built.	Name of Engine.	Name of Railroad Company.
1831	Liverpool	Petersburg.
1832	Roanoke	Richmond, Fredericksburg & Potomac.
1833	Meherrin	Raleigh & Gaston.
1833	Appomattox	" " "
1833	Creole	Pontchartrain.
1834	Staunton	Raleigh & Gaston.
1834	Petersburg	" " "
1834	Georgia	South Carolina.
1834	Augusta	" "
1835	Boston	Boston & Providence.
1835	Augusta	Richmond, Fredericksburg & Potomac.
1835	Fredericksburg	" " " "
1836	Lion	Boston & Worcester.
1836	Wilmington	Philadelphia & Wilmington.
1836	Orleans	Pontchartrain.
1837	John Randolph	Richmond, Fredericksburg & Potomac.
1837	Sheppard	" " " "
1837	Stafford	" " " "
1837	Patrick Henry	" " " "
1837	Roanoke	Raleigh & Gaston.

CONTRIBUTIONS TO PRACTICAL RAILROAD INFORMATION.

Chemistry Applied to Railroads.

SECOND SERIES.—CHEMICAL METHODS.

XII.—METHOD OF DETERMINING CHLORIDE IN AMMONIUM CHLORIDE.

By C. B. Dudley, Chemist, and F. N. Pease, Assistant Chemist, of the Pennsylvania Railroad.

(*Continued from page* 521.)

OPERATION.

Put about half a gram of the ammonium chloride into a 12-oz. beaker, and add 25 c.c. of distilled water. Allow to dissolve and then add 3 drops of a neutral solution of normal chromate of potash, and then solution of sodium carbonate until the liquid is faintly but clearly alkaline to litmus paper. Now run in from a burette standard silver nitrate solution, accompanied by vigorous stirring with a glass rod, or shaking of the beaker until the last drop of silver solution leaves a permanent red color. Read off the number of c.c. of silver solution used, and from these calculate the amount of chlorine present.

APPARATUS AND REAGENTS.

The apparatus required by this method needs no especial comment.

The normal potassium chromate solution is made by dissolving 10 grams of the C. P. salt in 100 c.c. of distilled water, and filtering if necessary.

The sodium carbonate solution is made by dissolving 20 grams of the dry C. P. salt in 100 c.c. of distilled water, and filtering if necessary.

The standard silver nitrate solution is made by adding 68 grams of crystallized C. P. silver nitrate to 2 litres of distilled water, allowing to dissolve, and then adding 5 drops of concentrated C. P. nitric acid. This solution is standardized as follows: Prepare first some pure sodium chloride by dissolving 100 grams of C. P. sodium carbonate in a slight excess of dilute hydrochloric acid, filtering into a royal Berlin porcelain dish, and allow to crystallize, carefully covered, in a warm place until half of the salt has crystallized out. Drain off the mother liquor, dissolve the crystals in distilled water, and crystallize again until half the salt has crystallized out. Carefully drain off the mother liquor and wash the crystals once with distilled water, then transfer to a clean platinum dish and carefully ignite at a temperature not above 400° F., to drive off moisture. Transfer the still warm salt to a carefully dried and closely stoppered weighing tube for use. After the weighing tube has become cold by remaining some time in the balance case, remove the cork to allow the air pressure to equalize, then replace it securely and weigh. Open now the tube and shake out into a 12-oz. beaker about 0.300 gram of the salt, quickly replace the cork again and weigh. The difference in the two weights shows the amount of salt taken. Suppose this to be 0.3288 gram. Dissolve the salt in about 25 c.c. of distilled water, add 3 drops of the chromate of potash solution, and enough of the sodium carbonate solution to render the liquid faintly but clearly alkaline to litmus paper. Now run in from the burette the silver nitrate solution with thorough agitation, either by stirring or shaking, until the last drop gives a permanent red color. Read off the number of c.c. of silver nitrate solution used. Suppose that 28.1 c.c. are required. Then since 60.68 per cent. of the sodium chloride is chlorine, it is evident that 28.1 c.c. of the silver nitrate solution is equivalent to [0.3288 × .6068] 0.1995 gram of chlorine, or 1 c.c. of the silver nitrate solution is equivalent to [0.1995 ÷ 28.1] 0.0071 gram of chlorine. Not less than two independent determinations of the strength of the silver nitrate solution should be made, and the duplicates should agree as to the strength of 1 c.c. of the solution within 0.00003 or 0.00004 gram.

CALCULATIONS.

Atomic weights: used sodium, 23; chlorine, 35.5; silver, 108; nitrogen, 14; oxygen, 16; hydrogen, 1. Molecular formulæ: sodium chloride, NaCl; silver nitrate, $AgNO_3$; ammonium chloride, NH_4Cl. Suppose the amount of silver nitrate solution used in an actual determination is 46.4 c.c. Then since each c.c. equals 0.0071 gram of chlorine, the total amount of chlorine present is [46.4 × 0.0071] 0.3294 gram, and if 0.4998 gram was taken to start with, the percentage of chlorine will be [0.3294 × 100 ÷ 4998] equals 65.91 per cent.

NOTES AND PRECAUTIONS.

It will be observed that this method dissolves the ammonium chloride in water, renders the solution distinctly alkaline with sodium carbonate, and then measures the amount of chlorine by means of a slightly acid silver nitrate solution using normal potassium chromate as indicator.

A rather large beaker is recommended, so as to enable the solution to be thoroughly agitated during the titration without danger of loss.

If the solution is not very thoroughly agitated during the titration, the coagulated precipitate of silver chloride is apt to retain some of the ammonium chloride solution, giving rise to low results. The agitation should be sufficient to break up the silver chloride into very small particles. The standard solution should be added very slowly at the last.

If the silver solution is entirely neutral, especially if it is exposed to the light, it is apt to change and slowly lose strength. This is apparently completely obviated by the presence of a little free nitric acid. But this free nitric acid introduces difficulty with the potassium chromate if the ammonium chloride solution is strictly neutral. Accordingly a small amount of sodium carbonate is introduced into this solution. The amount of this sodium carbonate must be enough to completely neutralize the free nitric acid, and a small excess introduces no difficulty.

WATER-TUBE BOILERS AND THEIR APPLICATION TO WAR VESSELS.*

By J. Nastoupil.

(*Continued from page* 551, *Volume LXVIII.*)

VI. The Niclausse water-tube boiler (figs. 17–19), as built by the *Société anonyme des générateurs inexplosibles* at Paris, consists of a series of vertical front tubes standing near each other, and a number of inclined water tubes which have their open ends fastened into the shells of the front tubes and are extended back into the furnace, where they are exposed to the action of the gases of combustion. Each front tube is connected at the top with a single steam drum, which in working conditions is half full of water.

Each front tube, which is made of malleable iron, is divided by a partition wall into two compartments. While at work a mixture of steam and water enters the inner chamber from the heating tube and rises into the drum, flowing down again through the outer chamber, and thence as cool water out into

* Paper read before the Wissenschaftlichen Verein der k. und k. Kriegsmarine.