UNITED STATES PATENT OFFICE.

HORACE L. WELLS, OF NEW HAVEN, CONNECTICUT, AND TOM COBB KING, OF EAST ORANGE, NEW JERSEY; SAID WELLS ASSIGNOR TO SAID KING; MARY H. KING EXECUTRIX OF SAID KING, DECEASED.

METHOD OF ELECTROLYTICALLY RECOVERING NICKEL.

1,067,698. Specification of Letters Patent. Patented July 15, 1913.

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To all whom it may concern:

Be it known that we, HORACE L. WELLS and TOM COBB KING, citizens of the United States, residing, respectively, at New Haven, in the county of New Haven and State of Connecticut, and East Orange, in the county of Essex and State of New Jersey, have jointly invented or discovered certain new and useful Improvements in Methods of Electrolytically Recovering Nickel, of which improvements the following is a description.

Our present invention relates to a new and useful method or process for separating and extracting nickel, and cobalt from a matte consisting largely of nickel and copper sulfids, or a combination of these with other metals, and recovering the acid solvent used.

The object of our invention is to produce an efficient and comparatively inexpensive process for obtaining nickel directly, from a matte, *i. e.* without roasting or producing metallic nickel.

In carrying out or practising our process we pulverize the matte and then treat it a plurality of times with hydrochloric acid diluted to contain from ten to thirty per cent. actual acid, the matte being treated with the acid until the nickel is largely dissolved, the time required being usually from one (1) to ten (10) or more hours dependent upon the quantity of matte treated, the chemical composition and physical condition of the same, the strength and amount of acid used, the amount of agitation given and the degree of heat applied during the treatment of the mixture. We have found in practice that the material should be pulverized to a fineness of 60 mesh or finer and that the acid should be heated to a temperature of from 110° F. to 210° F. The result of this treatment is the production of a green colored solution, which consists of nickel chlorid principally, there being present also certain quantities of iron chlorid and cobalt chlorid, if the matte contains the sulfids of same, and some chlorid of copper; and a black residue, being the unaffected portion of the matte consisting of copper sulfid principally, containing also gold, silver and metals of the platinum group if present in the matte. The object of using the diluted hydrochloric acid, is to obtain in solution a maximum amount of nickel and a minimum amount of copper from the pulverized matte in the initial step of the process; in other words, the hydrochloric acid has a greater solvent action upon nickel sulfid than upon copper sulfid as existing in the matte. We also dilute the acid for the purpose of economy in the use thereof, as when the acid is strong, hydrochloric acid gas vaporizes on the application of heat, whereas sufficiently diluted acid will stand the application of heat without appreciable diminution during the operation. We then take the solution resulting from the action of the aqueous hydrochloric acid on the matte, which consists of nickel chlorid principally, and treat fresh matte in a pulverized state therewith in the presence of sulfureted hydrogen, whereby copper is precipitated as a sulfid and free hydrochloric acid is formed, which attacks the fresh matte and dissolves therefrom more nickel. We then take the solution last obtained and expel any excess sulfureted hydrogen, by boiling or passing air or steam therethrough it. We take the last named solution and add thereto and mix therewith an amount of black oxid of nickel or chlorid in some form sufficient to oxidize the ferrous salts to ferric salts and add sufficient carbonate or ammonia water to precipitate the iron as hydroxid or as a basic salt. The product thus produced is then filtered; to the filtrate, if we desire to separate the cobalt, we then add a quantity of nickel oxid or its equivalent, nickel compound or chlorin and a carbonate sufficient to precipitate the black oxid of cobalt. We filter, recovering the cobalt by the usual process and the filtrate which is a very pure chlorid of nickel; we pass electricity through it, chlorin being liberated at the anode and the nickel deposited on the cathode. The chlorin gas liberated is brought in contact with sulfureted hydrogen there being formed hydrochloric acid gas which is recovered in water. Or, having obtained this nickel chlorid solution we can add sufficient sulfuric acid to form nickel sulfate by applying heat, thus driving off and recovering the hydrochloric acid gas in water. Using the nickel sulfate as an electrolyte an electric current being

passed through said electrolyte, metallic nickel is deposited on the cathode.

We claim—

1. The herein described process of extracting a metal directly from a matte as a chlorid solution, and recovering the acid solvent used, which consists in treating finely divided matte with hydrochloric acid, then subjecting the solution obtained to an electric current, whereby the metal is plated out and chlorin gas evolved, and finally treating the said gas with sulfureted hydrogen, and absorbing the produced hydrochloric acid gas in water.

2. The herein described process of extracting nickel directly from a matte as a chlorid solution and recovering the acid solvent used, which consists in treating finely divided matte with hydrochloric acid, then subjecting the solution obtained to an electric current, whereby the nickel is plated out and chlorin gas evolved, finally treating the said gas with sulfureted hydrogen and absorbing the produced hydrochloric acid gas in water.

3. The process of extracting chlorid forming metals from substances containing such metals which consists in treating said substances with hydrochloric acid, electrolyzing the resulting metal chlorid solution to deposit the metals and liberate chlorin, withdrawing the chlorin so liberated and combining it with hydrogen sulfid to regenerate hydrochloric acid.

In testimony whereof, we have hereunto signed our names in the presence of two subscribing witnesses.

HORACE L. WELLS.
TOM COBB KING.

In the presence of—
L. D. EAKINS,
M. D. CULLEN.