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UNITED STATES PATENT OFFICE.

BERT S. KIRKPATRICK, OF SAN PABLO, AND FRANK S. MORGAN, OF BERKELEY, CALIFORNIA, ASSIGNORS TO STANDARD OIL COMPANY OF CALIFORNIA, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

PROCESS OF PRODUCING ANHYDROUS METALLIC CHLORIDE.

No Drawing.

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To all whom it may concern:

Be it known that we, BERT S. KIRKPATRICK and FRANK S. MORGAN, both citizens of the United States, residing at San Pablo, Contra Costa County, California, and Berkeley, Alameda County, California, respectively, have invented a new and useful Process of Producing Anhydrous Metallic Chloride, of which the following is a specification.

10 Our invention relates to the manufacture of anhydrous metallic chlorides, and while applicable to the production of many anhydrous metallic chlorides, it is particularly useful in producing aluminum chloride.

15 The processes heretofore discovered or utilized for producing anhydrous chlorides, such as anhydrous aluminum chloride, have been found very expensive, owing to the high temperatures which are required to melt the metals to form their chlorides, or to form their chlorides from their compounds, and it has been found very difficult to produce apparatus which would withstand chlorine gas or anhydrous hydrochloric acid at the high
25 temperatures required.

We have discovered that by forming a mixture or alloy of the metal whose chloride is desired and a metal whose melting point is lower, but whose chloride is formed at a
30 higher temperature than that of the first metal, the melting point of the combined metals or alloy is reduced below the melting point of either of such metals, and that when chlorine gas or anhydrous hydrochloric acid is introduced into the molten metal or alloy
35 the anhydrous chloride of the metal having the lower chloride forming point is produced without having any substantial effect whatever upon the other metal, and that when the anhydrous chloride of such first mentioned
40 metal has been entirely formed the second metal will be left substantially unchanged except for slight oxidation. We have also found that the anhydrous metallic chloride
45 thus formed will be substantially free from the second metal.

By the use of a mixture or alloy of metals as stated the melting temperature of the mixture or alloy is much reduced, and it is
50 necessary only to provide sufficient artificial heat to bring the mixed metals or alloy to the melting temperature. When such mixed metals or alloy have been raised to the melting temperature chlorine or anhydrous hy-

drochloric acid is introduced to the molten
55 alloy and, as the reaction is exothermic, the artificial heat may then be discontinued and the heat of the reaction will be sufficient to continue the production of the metallic chloride of the given metal and may be con-
60 trolled by the flow of chlorine or hydrochloric acid onto or through the molten metal. For example: Assume that anhydrous aluminum chloride is desired to be produced. Equal quantities of aluminum
65 and zinc may be placed in a suitable closed retort and fused, and the alloy thus produced will have a lower melting point than that of either of the metals, or zinc may be melted in a closed retort and aluminum then
70 added and when the aluminum has been dissolved the temperature of the mixture reduced to approximately the melting point of the mixture or alloy thus formed. When
75 the mixture or alloy is at substantially the melting point of the alloy if the chlorine is introduced onto or preferably through the molten metal, aluminum chloride is formed. The external or artificial heat may be dis-
80 continued and the operation continued by the heat of the reaction. When all the aluminum has been converted into aluminum chloride the supply of chlorine may be shut off. The aluminum chloride is readily condensed or collected in any ordi-
85 nary receiver. The zinc will remain in the retort unaffected and can be reused as an alloy with further aluminum for the further production of aluminum chloride.

By thus mixing in the retort with the
90 metal whose chloride is to be produced an alloying metal whose chloride forming or vaporizing temperature is higher than the chloride forming or vaporizing tem-
95 perature of the first metal, and whose melting point is lower than the melting point thereof to produce a mixture or alloy of low melting point it has been found that the chloride of the high melting
100 point metal can be formed at lower temperature than the chloride of the lower melting point metal, and we are enabled to use a retort of the usual or ordinary construction
105 such as sand or clay crucibles, black lead, (graphite,) porcelain, silica wares, etc., or an iron retort may be used in forming most chlorides,—that is low temperature forming chlorides, by the use of a cooling jacket or

other suitable means of cooling the retort to prevent overheating of the walls of the retort, so that the chloride produced will not become contaminated with iron.

5 The process is not necessarily limited to the use of a mixture of two metals as, for instance, when it is desired to produce aluminum chloride if both zinc and cadmium are used it will be found that where 25%
10 cadmium is used and 37.5% each of aluminum and zinc are used the melting point of the alloy will be below that of cadmium, and aluminum chloride will form at about 200° C. The aluminum chloride produced by our
15 process will contain no zinc or cadmium chloride and an analysis of the alloy remaining in the retort will show that the cadmium and zinc remaining therein are not changed, other than by small oxidation.
20 tion.

Proportions of the metal whose chloride is to be produced and of the alloying metal or metals will vary in accordance with such metals and with the melting point to be
25 produced.

Herein we do not use the term "alloy" as signifying a composition of two or more metals in definite chemical relation but as indicating an admixture of one or more
30 metals to another for the purpose of reducing the melting point of the mixture or "alloy" thus formed.

We claim:

1. The process of producing metallic
35 chloride which consists in forming an alloy between the metal whose chloride is to be formed and a second metal having a chloride forming or vaporizing temperature higher than that of the first metal, which alloy has
40 a melting temperature between the chloride forming and vaporizing temperature of the first metal and such other metal and below the melting point of said first metal, bringing the alloy to a molten state, contacting

with chlorine, and collecting the resultant
45 metallic chloride.

2. The process of producing aluminum chloride which consists in forming an aluminum alloy with a second metal having a
50 chloride forming or vaporizing temperature higher than that of the aluminum chloride, which alloy has a melting temperature between the chloride forming and vaporizing
55 temperatures of the aluminum and the other metal and below the melting point of aluminum, bringing the alloy to a molten state, contacting with chlorine and collecting the resultant aluminum chloride.

3. The process of producing metallic
60 chloride which consists in forming an alloy of the metal whose chloride is to be produced with another metal which has a higher chloride forming or vaporizing temperature
65 than that of the first metal, which alloy has a melting temperature above the chloride forming or vaporizing point of said first metal and below the melting temperature
70 thereof, bringing said alloy to a molten state, contacting with chlorine, and collecting the resultant metallic chloride.

4. The process of producing aluminum chloride which consists in forming an aluminum alloy with another metal having a
75 higher chloride forming or vaporizing temperature than aluminum, which alloy has a melting point below that of aluminum and above its chloride forming or vaporizing
80 temperature, bringing said alloy to a molten state, contacting with chlorine, and collecting the resultant metallic chloride.

Signed at Richmond, California this 11th day of September 1920.

BERT S. KIRKPATRICK.
FRANK S. MORGAN.

Witnesses:

FREDERICK S. LYON,
L. BELLE WEAVER.