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METHOD OF REMOVING METALLIC COVERINGS FROM OTHER METALS.

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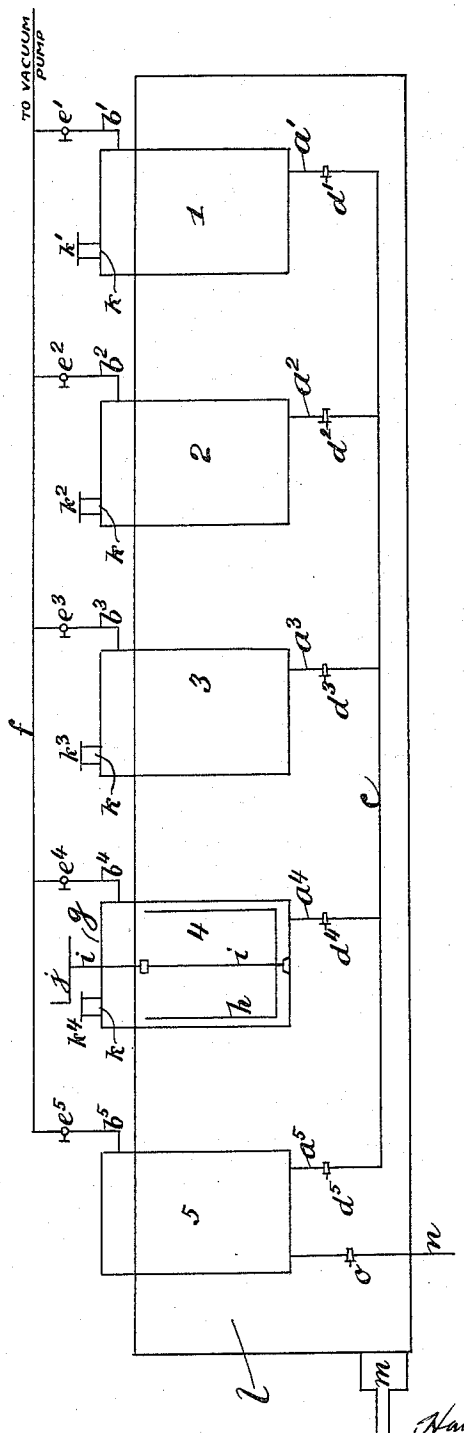


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# UNITED STATES PATENT OFFICE.

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## METHOD OF REMOVING METALLIC COVERINGS FROM OTHER METALS.

1,160,590. Specification of Letters Patent. Patented Nov. 16, 1915.

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*To all whom it may concern:*

Be it known that we, HANS FOERSTERLING, a subject of the Emperor of Germany, and HERBERT PHILIPP, a subject of the King of Great Britain, both residents of Perth Amboy, county of Middlesex, State of New Jersey, have invented a certain new and useful Method of Removing Metallic Coverings from other Metals.

This invention relates to a method of removing metallic coverings, such as tin for example, from other metals, such as iron for example, and has for its object to render such process of removal more expeditious, thorough and economical than heretofore.

In order to remove the usually more valuable metals which are used for covering other metals, substantially three principal methods exist today: The first of the above three methods is based upon the action of acids on the covering metals which dissolve the coverings leaving the residual metals more or less attacked by the acids. The second method consists in treating the covered metals by means of an electric current dissolving intermediately the covering metals and depositing the same afterward. The third method, which has been lately introduced in the detinning industry, is based upon the action of dry chlorin on the tin scrap forming volatile tin-tetrachlorid which is distilled off from the residual iron.

We have discovered a new method of removing the metallic covering from other metals, which has as its principle the formation of an alloy of one of the metals with a third metal and the subsequent separation of the alloy from the residual metal. The so formed alloy can then be further separated, if desired.

In order to explain our invention more fully we will describe one way of carrying out the same. For this purpose we will take as an example the process of detinning tin-scrap by our method.

In the accompanying drawing 1, 2, 3, 4 and 5 represent suitable closed containers, preferably in the form of iron vessels, provided with drain-pipes $a_1$ $a_2$ $a_3$ $a_4$ $a_5$ at the bottom and vacuum pipes $b_1$ $b_2$ $b_3$ $b_4$ $b_5$ near the top. The drain-pipes lead to a common pipe $c$ and are provided with cocks $d_1$ $d_2$ $d_3$ $d_4$ and $d_5$, respectively. The vacuum pipes $b_1$ $b_2$ $b_3$ $b_4$ and $b_5$ are similarly provided with valves $e_1$ $e_2$ $e_3$ $e_4$ $e_5$ respectively, and lead to a common vacuum pipe $f$ which is connected with a vacuum pump, not shown in the drawing. The cover of vessel 4 for example, may be removable and the vessel provided with a wire basket $h$ which can be rotated by a shaft $i$ and the wheel $j$. The shaft is preferably made in two pieces adapted to be locked together in any suitable manner in order to allow the cover to be taken off without lifting out the basket. Vessels 1 2 3 and 4 each have an opening $k$ in the top provided with suitable covers $k_1$ $k_2$ $k_3$ and $k_4$ respectively. Vessel 5 has an extra drain-pipe $n$ with a cock $o$. All vessels 1 2 3 4 and 5 are set in a common furnace $l$ which is heated by any suitable means as by gas from the gas burner $m$. Dry tin-scrap is placed in the basket $h$ in the vessel 4, the cover $g$ being removed for the purpose and then replaced. Cocks $d_1$ $d_2$ $d_3$ $d_4$ $d_5$ and $o$ and valves $e_1$ $e_2$ $e_3$ $e_4$ and $e_5$ are shut. A suitable molten metal such as molten metallic sodium is put in vessel 4 through opening $k$ until it covers the tin-scrap and then the cover $k_4$ is closed. The basket is rotated and the sodium kept molten by means of the gas-burner $m$, and the sodium alloys at once with the tin from the tin-scrap. Vessel 2 is then evacuated by opening valve $e_2$ and starting the vacuum pump. Cocks $d_2$ and $d_4$ are then opened and the sodium tin alloy is transferred into vessel 2, the scrap in the basket being kept in rotation.

After all the tin sodium alloy has been transferred into vessel 2 cocks $d_2$ and $d_4$ and valve $e_2$ are shut. The cover $g$ of vessel 4 is taken off and the basket $h$ is lifted out and the residual iron removed. The basket is then replaced in vessel 4, fresh tin-scrap is put in and the cover $g$ put on again. Valve $e_4$ is then opened and a vacuum created in vessel 4 by means of the vacuum pump. Cocks $d_4$ and $d_2$ are opened and the weak tin sodium alloy is transferred from vessel 2 into vessel 4. Cocks $d_4$ and $d_2$ are closed as soon as the alloy is transferred and the fresh tin-scrap is treated with the weak tin sodium alloy thus transferred from vessel 2. The alloy is then transferred back to vessel 2 in the manner above described. In the meantime vessel 1 has been charged with fresh molten sodium through cover $k^1$ in an

amount substantially equivalent to the amount put into vessel 4 at the start. After the second batch of tin-scrap has been treated with the weak tin sodium alloy from vessel 2 it is treated by the means shown and described with clean sodium from vessel 1 in order to remove the last traces of tin. Basket *h* is again emptied and refilled and the scraps treated with alloy from vessel 2 and subsequently with weaker alloy from vessel 1 and the operations repeated until the tin percentage in the tin sodium alloy in vessel 2 has reached for example approximately 25%. The alloy is then transferred by vacuum as described from vessel 4 into vessel 3, the contents of vessel 1 are transferred into vessel 2 and 1 is charged with fresh sodium. Vessel 3 is now charged with approximately 25% tin sodium alloy, vessel 2 with weak sodium alloy and vessel 1 with fresh sodium. Basket *h* is now emptied again and refilled with tin scraps. By the means described the contents of vessel 3 are transferred to vessel 4 and back again; then the contents of vessel 2 to vessel 4 and back again; then the contents of vessel 1 to vessel 4 and back again. This series of operations is repeated until the tin sodium alloy in vessel 3 has reached approximately 50% tin. It is then transferred into vessel 5 whence it may be drawn off by the drain pipe *n* and through cock *o*, as desired. The contents of vessel 2 is then transferred to vessel 3, the contents of vessel 1 to vessel 2 and vessel 1 charged with fresh sodium as before and the operation is repeated. In other words, our process consists of washing the tin-scrap first with tin sodium alloy containing 25 to 50% tin from vessel 3, then with an alloy containing 5 to 25% tin from vessel 2 and at last with pure sodium or an alloy up to 5% tin from vessel 1. The rich tin sodium alloy coming from vessel 5 can be further decomposed or used as such.

The rapidity with which the sodium acts on tin-scrap is surprising. We have found that an alloy containing 60% tin and 40% sodium detins tin-scrap containing 1.8% tin in 10 minutes down to 0.44% tin; an alloy containing 50% tin and 50% sodium detins tin-scrap containing 1.8% tin in 10 minutes down to 0.22% tin; an alloy containing 40% tin and 60% sodium detins tin-scrap containing 1.8% tin in 10 minutes down to 0.13% tin; and an alloy containing 30% tin and 70% sodium detins tin-scrap containing 1.8% tin in 10 minutes down to 0.018% tin.

As the action of sodium and sodium tin-alloy upon tin-scrap is so rapid and the higher alloys do not melt much below 400° C., we prefer to keep vessel 4 at about 400° C. throughout the process although when using weak tin-sodium alloy or pure sodium such temperature is not necessary.

The main advantage of our method over the ones practised so far consists in recovering the tin in form of an alloy. The tin can be easily separated as a metal from the sodium, as for instance, by distilling off the latter in a vacuum. The distilled sodium can then be used over again.

An additional advantage is that the residual iron when removed from vessel 4 still contains traces of sodium and when molten, shows a superior quality over ordinary iron. Of course it must be understood that we do not limit ourselves to the process as described. Other apparatus for detinning by means of an alkali metal according to our method may be used. For instance an apparatus may be constructed through which the tin-scrap is carried continuously against a current of molten alkali metal flowing in the opposite direction. Instead of removing tin from iron other metal coverings from other metals may be removed, as for instance, zinc or lead from iron without departing from the spirit of our invention.

What we claim is:

1. The method of removing metallic coverings from other metals consisting in treating the same with an alkali metal, the latter forming an alloy with the covering metal.

2. The method of removing metallic coverings from other metals consisting in treating the same with sodium, the latter forming an alloy with the covering metal.

3. The method of detinning tin-scrap consisting in treating the tin-scrap with an alkali metal, the latter forming an alloy with the tin.

4. The method of detinning tin-scrap consisting in treating the tin-scrap with sodium, the latter forming an alloy with the tin.

5. The method of detinning tin-scrap consisting in treating the tin-scrap with an alkali metal and forming an alloy with the tin, separating the tin alkali metal alloy from the iron and separating the tin from the alkali metal.

6. The method of detinning tin-scrap consisting in treating the tin-scrap with sodium and forming a tin sodium alloy, separating the tin sodium alloy from the iron and separating the tin from the sodium.

7. The method of detinning tin-scrap consisting in treating the tin-scrap with an alkali metal and forming an alloy with the tin, separating the tin alkali metal alloy from the iron and separating the tin from the alkali metal by distillation.

8. The method of detinning tin-scrap consisting in treating the tin-scrap with sodium and forming tin sodium alloy, separating the tin sodium alloy from the iron and separating the tin from the sodium by distillation.

9. The method of detinning tin-scrap consisting in treating the tin-scrap with an alkali metal and forming an alloy with the

tin, separating the tin alkali metal alloy from the iron and separating the tin from the alkali metal by distilling off the latter from the tin in a vacuum.

10. The method of detinning tin-scrap consisting in treating the tin-scrap with sodium and forming a tin sodium alloy, separating the tin sodium alloy from the iron and separating the tin from the sodium by distilling off the latter from the tin in a vacuum.

11. The method of removing metallic coverings from other metals consisting in successively treating the same with an alkali metal adapted to form an alloy of gradually increasing richness with one of the metals treated.

12. The method of removing metallic coverings from other metals consisting in successively treating the same with sodium to form an alloy of gradually increasing richness with one of the metals treated.

13. The method of detinning tin-scrap consisting in successively treating the tin-scrap with another metal melting at a lower temperature than tin to form a tin alloy of gradually increasing richness.

14. The method of detinning tin-scrap consisting in successively treating the tin-scrap with an alkali metal to form a tin alloy of gradually increasing richness.

15. The method of detinning tin-scrap consisting in successively treating the tin-scrap with sodium to form a sodium tin alloy of gradually increasing richness.

16. The method of detinning tin scrap which consists in treating tin scrap with sodium to form a comparatively weak tin sodium alloy and successively treating fresh tin scrap with said alloy until the alloy is of the desired richness.

17. The method of detinning tin scrap which consists in treating tin scrap with sodium to form a comparatively weak tin sodium alloy, removing the tin sodium alloy, retreating the tin scrap with fresh sodium, removing the tin sodium alloy thus formed and successively treating fresh tin scrap with said alloy in the manner described until the alloy is of the desired richness.

18. The method of removing metallic coverings from other metals consisting in treating the same with a third metal melting at a lower temperature than any of the metals contained in the covered metal and forming an alloy with the covering metal.

19. The method of removing metallic coverings from other metals consisting in treating the same with a third metal melting at a lower temperature than any of the metals contained in the covered metal, said third metal forming an alloy with the covering metal, separating the alloy from the residual metal and decomposing the former into its constituents.

20. The method of removing metallic coverings from other metals consisting in treating the same with an alkali metal, the latter forming a weak alloy with the covering metal, washing the residual metal with the alkali metal to obtain another and weaker alloy of the same components, treating another fresh charge of covered metal successively with such various grades of the alloy obtained, repeating the operation until the oldest alloy contains a maximum of approximately 50% of the covering metal, withdrawing from the operations the alloy containing the maximum covering metal, introducing another charge of fresh alkali metal corresponding to the amount of such withdrawn with the alloy and separating the alloys from the residual metal after the same is freed from the covering metal.

21. The method of removing tin from tin-scrap consisting in treating the same with an alkali metal, the latter forming a weak alloy with the tin, washing the iron with the alkali metal to obtain another and weaker tin-alkali metal alloy, treating another fresh charge of tin scrap successively with such various grades of tin alkali metal alloy obtained, repeating these operations until the oldest alloy contains a maximum of approximately 50% tin, withdrawing from the operations the alloy containing the maximum of tin, introducing another charge of fresh alkali metal corresponding to the amount of such withdrawn with the alloy, and separating the alloys from the iron after the same is freed from the tin.

22. The method of removing tin from tin scrap consisting in treating the same with sodium, the latter forming a weak tin-sodium alloy, washing the remaining iron with sodium to obtain another and weaker tin sodium alloy, treating another charge of fresh tin scrap successively with such various grades of tin sodium alloys obtained, repeating these operations with other fresh tin scrap until the oldest alloy contains a maximum of approximately 50% of tin, withdrawing from the operations the alloy containing the maximum of tin, introducing another charge of fresh sodium corresponding to the amount of such withdrawn with the alloy, and separating the alloys from the iron after the same is freed from the tin.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

HANS FOERSTERLING.
HERBERT PHILIPP.

Witnesses:
FRITZ HOYLER,
OTTO W. WISE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."