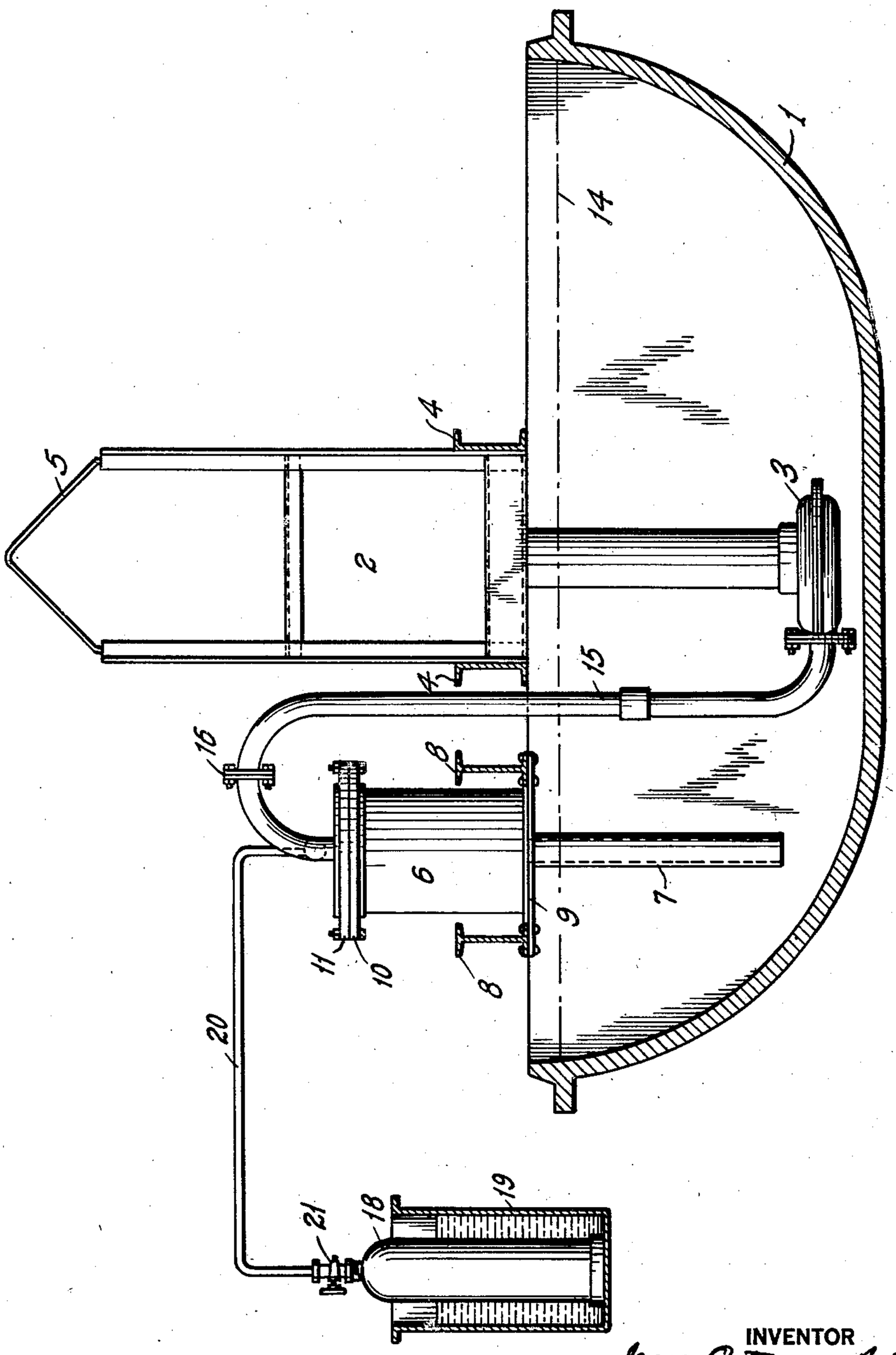
May 9, 1933. J. O. BETTERTON 1,907,481

SELECTIVE CHLORIDIZATION OF METALS

Filed Dec. 20, 1930



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Patented May 9, 1933 1,907,481

UNITED STATES PATENT OFFICE

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SELECTIVE CHLORIDIZATION OF METALS

Application filed December 20, 1930. Serial No. 503,702.

This invention relates to a process for refining metals, and more particularly to a process for separating meals by selective chloridization.

The invention is applicable to the separation of various metals which can be selectively chloridized and provides for introducing chlorine into a bath of molten metals under such conditions that an efficient separation may be obtained.

This application is a continuation in part of my copending application Serial No. 145,402, filed November 1, 1926, for Method of dezincing lead, which issued as Patent No. 1,792,210 on February 10, 1931.

In applying chlorine to certain metals for the formation of metal chlorides, it has been found that the process is impeded by the tendency of the metals to oxidize and by the difficulty of maintaining a fluid slag of the metal chlorides. The present invention provides for overcoming these difficulties by causing the slag to remain fluid at the temperature of treatment and by introducing the chlorine under such conditions that oxidation of the metals is largely prevented. For this purpose a cover consisting of a chloride slag of comparatively low melting point is maintained on the surface of the bath and the chlorine is introduced into the bath under this slag. The slag forms a seal over the surface of the bath and prevents undesirable oxidation and also mixes with the chlorides which are produced and forms a mixture which remains fluid at the temperature of the bath.

The invention also provides for introducing the chlorine under such conditions that corrosion of the apparatus is reduced to a minimum.

The invention is particularly useful in removing various metals such as zinc, aluminum, magnesium and alkali earth metals from lead or an alloy of lead and other metals, such as antimony, bismuth, etc. Likewise it may be applied to the separation of other metals, as for example, lead from mixtures of bismuth and lead, or antimony and lead, or antimony, arsenic and lead; also for the separation of alkali earth metals and/or magnesium from zinc or lead and zinc or lead from bismuth. In general the invention is useful for the separation of any metal which is more readily chloridized from a metal which is less readily chloridized.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out may be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which the figure is an elevation of a form of apparatus suitable for carrying out the process.

In the following description and in the claims parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring now to the drawing, the kettle 1 may be filled with molten metal containing a readily chloridizable impurity to the height indicated by the line 14. Supported by the top rim of the kettle is a unit comprising a motor 2 and pump 3, the motor being supported as by channel irons extending across the kettle and resting upon the rim thereof. The pump is suspended from the motor and is located preferably near the bottom of the kettle. The unit may be provided with a link 5 by means of which the unit may be carried about the plant.

Supported also on the rim of the kettle 1 is a reaction chamber 6, the bottom being closed and having a discharge pipe 7 connected thereto which extends down beneath the surface of the bath a suitable distance. The reaction chamber 6 may be supported by two I-beams 8 extending across the kettle, the I-beams having secured at their lower flanges transverse members 9 on which the reaction cylinder rests. The top of the reaction chamber may be provided with a flange 10 to which

may be secured a head 11. A connecting pipe 15 may be connected from the reaction chamber, this pipe having a flanged union 16 for a purpose hereinafter described.

Located conveniently near the kettle may be the source of chlorine, which may be in the form of a chlorine tank 18 immersed in a vessel 19 filled with water and kept at an appropriate temperature. Suitable piping 20 may connect the chlorine tank with the reaction cylinder and a valve 21 may be provided for controlling the flow of the chlorine.

In carrying out the above process the motor and pump and reaction chamber are placed in position on the kettle which has been filled with molten metal to the level indicated for example, by line 14. Appropriate connections may then be made between the various parts of the apparatus after which portions of the molten metal may be withdrawn from the bath by means of pump 3 and supplied to the reaction chamber and caused to flow downwardly therein. At the same time chlorine is introduced. from chlorine cylinder 18 and caused to react with the impurities in the molten metal.

The rate of passage of the molten metal through the reaction chamber and rate of application of the chlorine gas thereto may be controlled by suitable regulation of pump 3 and valve 21 respectively so that the chlorine is adsorbed by the metal due to the resultant reaction at a rate such as to produce a partial vacuum in the reaction chamber and cause the metal of the bath to rise an appreciable distance therein.

By operating the apparatus with a partial vacuum the chlorine does not attack the walls of the chamber to an appreciable extent, and the tendency of the chamber to corrode is reduced to a minimum. Furthermore, it is to be noted that the release from pressure of the chlorine from the high pressure of the original tank or bottle to the pressure of the reaction chamber will cause the same to undergo a drop in temperature which will tend to neutralize the heat of the reaction and prevent the temperature of the bath from rising above the desired value. Furthermore, the circulation of the metal caused by the above described apparatus serves to agitate the bath below the surface thereof and assists in securing the desired reaction.

In applying the process specifically to the treatment of a lead bath to remove impurities therefrom as chlorides, the bath may be heated to a temperature adapted to efficiently carry on the reaction, preferably a temperature between the melting point of lead and 1000° F., as for example, 670° F. to 750° F. It is desirable to avoid a temperature above these limits in order to reduce the corrosion of the containers by the chlorine gas.

A chloride slag of a readily fusible chloride, such as a zinc chloride, is then added or allowed to accumulate on the bath in sufficient quantities to completely cover and seal the same and prevent oxidation by contact with the atmosphere. This slag may be formed from the bath and allowed to accumulate or may be added thereto depending upon the impurities which it is desired to remove.

In treating a lead bath for the removal of zinc, for example, by the introduction of chlorine, a zinc chloride slag will rapidly form and may be allowed to accumulate on the surface thereof and will be fusible at the above mentioned temperature range although a portion of the slag at the surface may solidify due to the heat radiation therefrom. The fluid portion however completely covers and seals the bath.

In treating a lead bath for the removal of certain other metals, such as alkali earth metals, it is preferable to introduce a slag of zinc chloride from an external source inasmuch as the alkali earth metal chloride would be infusible at the temperature range above mentioned and would form a so-called dry dross which would not spread over the bath nor form an effective seal. Furthermore, the oxidation of the bath would produce litharge which would also be insoluble at the above temperatures and further impede the process.

In addition a secondary reaction occurs between the chlorides of the alkali earth metal, zinc and/or lead to form a chloride of the alkali earth metal which enters the slag, throwing the lead or zinc back into the bath.

After the surface of the bath has been covered by a molten slag either separately introduced or formed therein, as above described, chlorine is introduced by continuously withdrawing a portion of the bath and passing it through the reaction chamber wherein it is reacted with chlorine to form chlorides which are carried by the stream back into the bath. The chlorides then rise to the surface and mix with the slag which is already present thereon.

The chloride slag which is produced may be removed from the bath in any suitable manner and treated for the recovery of the metal values therefrom.

The invention has been described for convenience as applied to certain metals but it is obvious that it is applicable to other combinations of metals which are selectively chloridizable and that the metals specifically mentioned are only illustrative.

Although certain novel features of the invention have been shown and described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the several steps of the process and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. The process of treating a molten metal for the removal therefrom of a more readily chloridizable metal which comprises continuously removing a portion of said molten metal from a bath and passing said portion through a reaction chamber while admitting chlorine to said chamber at such a rate that a partial vacuum is continuously produced therein and then returning the products of reaction to the bath.

2. The process of treating molten lead for the removal therefrom of a more readily chloridizable metal which comprises continuously removing a portion of said molten lead from a bath and passing said portion through a reaction chamber while admitting chlorine to said chamber at such a rate that a partial vacuum is continuously produced therein and then returning the products of reaction to the bath.

3. The process of treating molten lead for the removal of zinc therefrom which comprises continuously removing a portion of said molten lead from a bath and passing said portion through a reaction chamber while admitting chlorine to said chamber at such a rate that a partial vacuum is continuously produced therein and then returning the products of reaction to the bath.

4. In the selective chloridization of metals the improvement which comprises establishing a molton bath of such metals, covering the surface of said molten bath with a readily fusible metallic chloride slag which will be increased in quantity by the chloridizing operation as same progresses, continuously withdrawing portions of the molten bath and subjecting same to the action of chlorine in a closed reaction chamber and returning the reaction products thereof to the molten bath at a point substantially beneath the chloride slag.

5. The process of purifying metal contaminated with one or more metals of the alkaline earth group which comprises establishing a molten bath of said contaminated metal, applying a readily fusible metallic chloride cover to said bath in quantities sufficient to seal the bath from contact with the atmosphere, continuously removing a portion of said contaminated metal from the bath and passing same into a reaction chamber in intimate contact with chlorine gas and returning the reaction products therefrom to the bath.

6. The process of purifying metal contaminated by one or more other metals which comprises establishing a molten bath of said contaminated metal, applying a readily fusible metallic chloride cover to said bath in quantities sufficient to seal the bath from contact with the atmosphere, removing a portion of said contaminated metal from the bath and passing same into a reaction chamber while admitting chlorine to said chamber at such a rate that partial vacuum is continuously produced therein, and returning the reaction products from the reaction chamber to the molten bath at a point below said chloride cover.

7. In the removal of a readily chloridizable metal from a mixture of such metal and a metal having less affinity for chlorine, the improvement which comprises establishing a molten bath of such metals, continuously withdrawing a portion of the molten metal mixture from said bath and introducing same into a closed reaction chamber in the presence of chlorine gas whereby the chlorine preferentially reacts with the more readily chloridizable metal of the mixture, and returning the reaction products to the molten bath substantially below the surface thereof whereby the chloride of the more readily chloridizable metal rises to the surface of the bath and completely seals same from contact with the atmosphere.

In testimony whereof I have hereunto set my hand.

JESSE OATMAN BETTERTON