

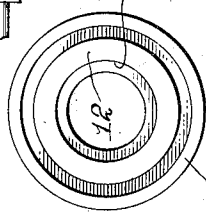
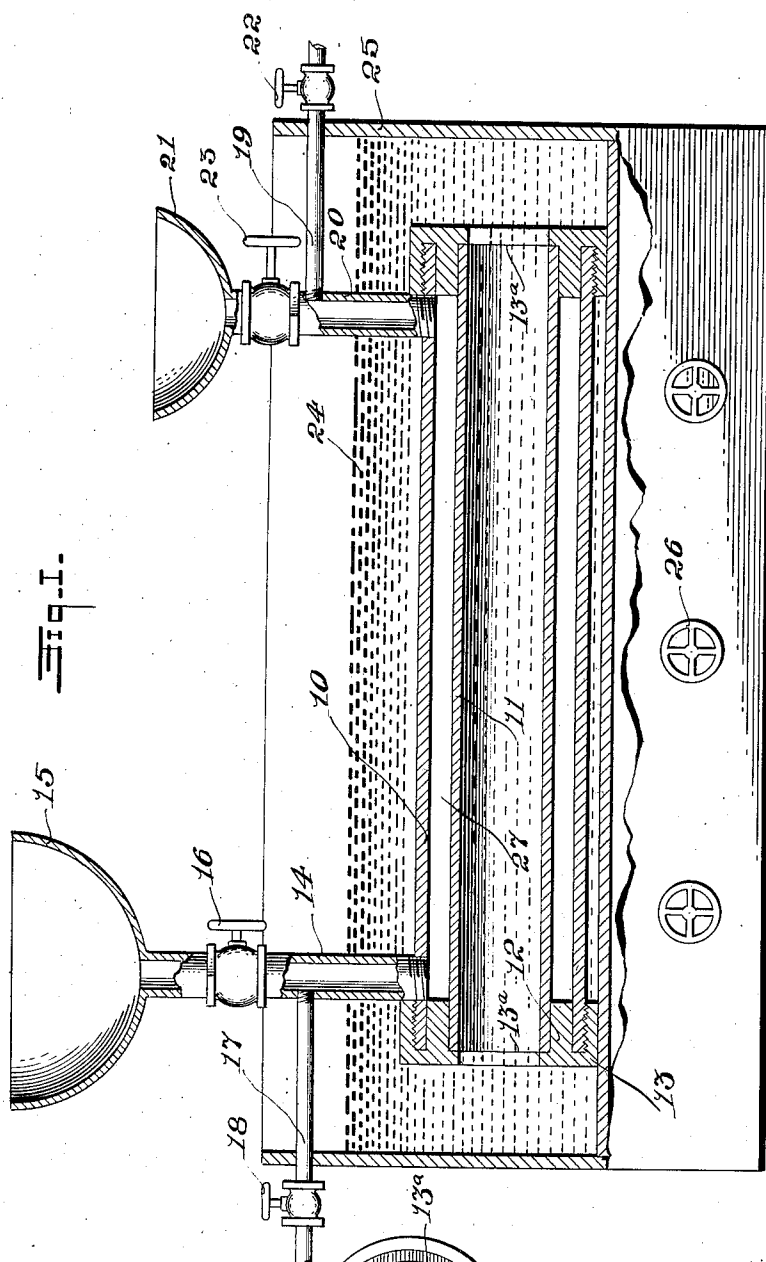
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PROCESS OF COATING METALS

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WITNESS:

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PROCESS OF COATING METALS

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The present invention relates to the covering or coating of a metallic surface with another metal.

With metallic pipes, boilers, pans and other vessels coated with a protective covering or coating of another metal by processes heretofore known, difficulty has been experienced in preventing the separation of the covering metal from covered surfaces when the same is subjected to heat, torque or vacuum and under various other influences. The pipes, vessels and other utensils, therefore, soon deteriorate and are rendered useless, in addition to vitiating the product being treated in such vessels.

An object of the invention is to provide a process whereby a covering metal may be united with a metallic surface so as to insure adherence of the metals together in an inseparable bond under all conditions of strain, torque, vacuum influences, pressure, vibrations and heat up to the melting point of the covering metal.

A further object of the invention is to so apply the covering metal to the surface to be covered as to provide in the application of the metal a covering of uniform thickness and homogeneity, free from air pockets, "pin holes", or other faults in the construction thereof, and without the necessity of subsequent shaping or leveling after the covering has been applied.

Further objects of the invention are simplicity of process and apparatus, facility and economy in operation, and certainty of the final product.

The process consists briefly in applying the coating metal to the metallic surface to be coated in a molten state and in a reducing atmosphere.

This process may be carried out by the employment of certain apparatus for confining the coating metal in contact with the surface to be coated, and providing means for introducing a volatile reducing agent between the surface to be coated between a wall of said apparatus and the surface to be coated.

While the process is especially applicable in the uniting of a covering of lead to an iron base, its use is contemplated in the pres-

ent application in the covering of any given metallic surface with another metal or alloy whose melting point is sufficiently below that of the surface to be covered.

In the subsequent discussion, therefore, the reference to lead and iron or lead and steel, by way of exemplification, is not to be taken as meaning that the process is applicable only as related to these metals.

I have found that lead and other metals suitable for covering purposes may be made to adhere tenaciously to the surfaces of their bases by applying them to the following process, and that such covering will not be dislodged from the base under any of the ordinary stresses or influences to which they may be subjected as torque, bending, vacuum, pressure, vibration or temperature up to the melting point of the covering metal.

In applying my process to the coating of steel or cast-iron with lead, the surface of the iron or steel to be covered or coated is first thoroughly cleaned so as to free it from scale, rust, dirt and other objectionable substances. This cleaning may be accomplished by the application of either a sand blast or one of the well known pickling agents, or by the successive application of both.

Suitable pickling agents are hydro-fluoric acid, HF; nitric acid, HNO₃; hydro-chloric acid, HCl; sulphuric acid, H₂SO₄; applied at a range of temperatures varying from 100° to 160° F. according to the metal in question and the acid to be used.

The concentration of these pickling agents may vary, also, according to the acid and to the metal treated between 10% and 50%.

The particular acid used may be varied with the metal to be treated as for instance, hydro-fluoric acid is found to be particularly effective in the pickling of silicon iron, especially when used in a concentration of about 30%. Hydrochloric acid is quite effective when applied to chrome steel at a concentration of between 20 and 50% while nitric acid has particular application to the pickling of copper and brass in a dilute solution of about 10%. A 20% solution of sulfuric acid may be effectively used in the pickling of usual varieties of iron and steel.

After the pickling operation the acid is washed off and the metal to be coated may be subjected to a fluxing treatment and to a preheating as will presently be more fully set forth. Both of these steps are optional and may be used or omitted as occasion or convenience may dictate.

Where fluxing is desired suitable fluxing agents are ammonium chloride NH_4Cl or zinc chloride ZnCl_2 . Antimony chloride SbCl_3 may also be effectively used and other suitable chlorides varying with conditions.

The concentration and temperature of the fluxing salts are important in their application to the metallic surface to be coated, working best around the concentration point of the particular salt used, although the work is also effective in a weak solution and over a range up to the saturation point; the temperature of the solution should be around 160°F. for most effective results.

After the flux has been applied to the metallic surface to be coated, the same may be preheated to the melting point of metal to be used as a coating or covering agent. This step may be resorted to as a matter of economy in time and when resorted to, may take place in an enclosed furnace or otherwise, as desired.

The metallic coating or covering is next applied to the cleaned surface of the metal and this may be done in any suitable manner, as by pouring or dipping; the coating metal being, of course, in a molten state. The coating metal may be effectively applied in a reducing atmosphere as of pure, dry hydrogen.

The lead used is preferably in a pure chemical state or, where a hard lead surface is desired, an antimony lead may be used, that is, lead containing antimony over a range up to about 10% beginning with a fraction of one per cent.

The covering may be effectively applied in an enclosure having a surface or wall spaced from the surface to be covered a distance equal to the thickness of the covering or coating desired. The casing and other apparatus used in connection with the coating is preferably made of a high temperature alloy, or chrome steel or chrome-nickel steel, as such alloys are least effected by temperature changes. The molten lead may be introduced into the enclosure between these surfaces, the article to be coated being maintained the while at the temperature of molten lead. This may be accomplished by submerging the enclosure in a bath of molten lead maintained in a molten condition in any well known manner.

The preliminary heating of the article to be coated may take place in this bath but to save time it may be preheated in a furnace, as set forth above.

Excellent results are obtained by applying the covering or coating in a reducing atmos-

phere suitably introduced into the enclosure along with the molten lead, hydrogen being an excellent medium for this purpose.

Preliminary to the introduction of lead into the enclosure, an atmosphere of hydrogen may be passed through the enclosure until tests show that all air has been driven out. The application of the molten lead at a uniform temperature throughout the mass in an enclosure and in an atmosphere of hydrogen with provision for escape of the air and other gases relieves the lead of occluded air and other impurities and insures homogeneity of structure for the covering while the application within the enclosure, as set forth above, insures uniformity of thickness.

In the accompanying drawings is illustrated apparatus for covering a pipe with a metallic layer.

In the drawings:—

Figure 1 is a longitudinal section through the apparatus and,

Figure 2 is a closure cap for the enclosure for the pipe.

This apparatus comprises a tubular enclosure or casing 10 in which the pipe 11 to be covered, in the present instance on its outer surface, is suitably supported in coaxial spaced relation to the inner wall of the casing, as by gauges 12 which may be separably or integrally formed with closure caps 13 for the ends of the casing. These caps may be provided with central openings 13^a to allow free flow of the molten metal of the bath through the pipe being coated, thus maintaining more uniform temperature.

The inner surface as well as the outer surface of the enclosure 10 are untreated by either the sand blast or pickling processes described above and are left in an uncleaned condition in order to prevent adhesion of covering metal thereto. The pipe 11 on the other hand is cleaned by one or both of these methods before being mounted in the casing. The thickness of the gauge used will correspond to the thickness of covering desired on the pipe 11 and the casing must also be selected of a suitable diameter with this end in view.

As stated above, the caps 13 may have the gauges formed integrally therewith and in this case a plurality of cups must be provided with gauges of varying diameter formed thereon for each diameter of casing used.

The molten metal is supplied to the interior of the casing through a conduit 14 leading from a "balancing" cup 15, the flow being controlled by a hand valve 16 beneath which a pipe 17 is provided communicating with the conduit for supplying a reducing agent into the casing simultaneously with the molten metal for reducing any oxides that may be contained therein, causing the reducing agent to start flowing prior to the admission of the molten metal and stopping the flow

of the reducing agent prior to the cutting off of the flow of molten metal. The flow of reducing fluid through this pipe is controlled by valve 18. The pipe also serves for the introduction of hydrogen preliminary to the introduction of the molten metal for driving out air and other gases.

To this end an outlet pipe 19 for the gas is provided communicating with the conduit 20 leading from the casing 10 to a balancing cup 21. The pipe 19 is controlled by a valve 22 and the conduit 20 by the valve 23.

It will be noted by reference to the drawings that the balancing cup 15 is of considerably greater capacity than the cup 21 and that its bottom is on a level with the top of cup 21. By this arrangement pouring of the molten metal is facilitated and the pouring may be continued until the metal overflows the cup 21. A further function of these cups with their conduits extending in a vertical direction from the enclosure is to insure the escape of all occluded air and other gases in the molten coating mass.

The molten metal and the pipe to be covered should be maintained at uniform temperature throughout the mass until the pouring is completed, a suitable temperature being that of the molten metal. A convenient manner of accomplishing this is to submerge the casing the while in a bath of molten metal 24 of the same character as the coating or covering metal.

This bath is contained in a receptacle 25 which may be heated in any suitable manner, as by gas burners controlled by valves 26.

In carrying out the process in this apparatus, the bath 24 is first brought to a molten state, the reducing fluid, as hydrogen, is caused to pass through the casing 10 by opening valves 18 and 22 until a test shows the interior of the casing to be free from air.

It will be noted that the conduits 14 and 20 communicate with the space 27 between the pipe to be coated and the casing at the extreme ends thereof in order to provide a flow of reducing hydrogen the entire length of the surface to be coated, thus preventing air pockets or regions untreated by the reducing agent.

The space 27 having been freed of air, the valves 16 and 23 are opened and molten metal allowed to flow into the space 27 completely filling the same and overflowing cup 21 into the bath 24; the valve 22 the while being closed and the valve 18 open until near the end of the flow of the molten metal. When the space 27 is so filled and the height of the molten metal is the same on both sides, i. e., balance each other, and the operator is satisfied that the reducing agent has acted sufficiently to give the desired result, the valves 16 and 23 may be shut off and the casing 10 removed from the bath and allowed to cool.

With the surface of the pipe treated as

above, a bond will be formed between this surface and the covering metal inseparable under ordinary conditions of torque, vacuum influence, severe vibrations, pressure or heat up to the melting point of the covering metal.

The coating obtained is non-porous, free from pin holes or gas pockets, and a homogeneous union of the two metals is provided.

The process also has the advantage of simplicity, economy and applicability to the union of various metals of sufficiently dissimilar melting points and to the coating of metal in various forms.

It should be here emphasized that sheet metal, interiors as well as exteriors of pipe, vessels of various characters and shapes and all sorts of metallic structure may be covered with a dissimilar metal by the above process by adapting the apparatus to the specific conditions to be dealt with.

I claim:—

1. The process of casting one metal upon the surface of another, consisting in cleaning the surface of the base metal to receive the cast, enclosing the base metal within a chamber defining the elected cast, raising the temperature of all to the melting point of the casting metal by submersion in a bath of the casting metal in molten condition, educting the oxygen from the chamber, pouring the casting metal in molten form into the chamber along with nonoxidizing gas to exclude oxygen in the pouring and cooling the cast.

2. The process of casting one metal upon the surface of another, consisting in cleaning the surface of the base metal, positioning the base metal in a mold, heating the base metal and mold to approximately the melting point of the casting metal, and applying the casting metal to the base metal in molten form together with a permeation of non-oxidizing gas.

3. The process of casting one metal upon the surface of another, consisting in cleaning the surface of the base metal, positioning the base metal body in a mold spaced from the base metal by a chamber defining the cast to be made, heating the base metal and mold to approximately the melting point of the casting metal, and applying the casting metal to the base metal by introducing into the mold in molten form together with a permeation of non-oxidizing gas.

In testimony whereof I have signed my name to this specification.

FRANCIS RICHARD GLENNER.