Feb. 17, 1953 A. P. KNAPP 2,628,393

METHOD AND APPARATUS FOR COATING METALLIC OBJECTS

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Fig. 1

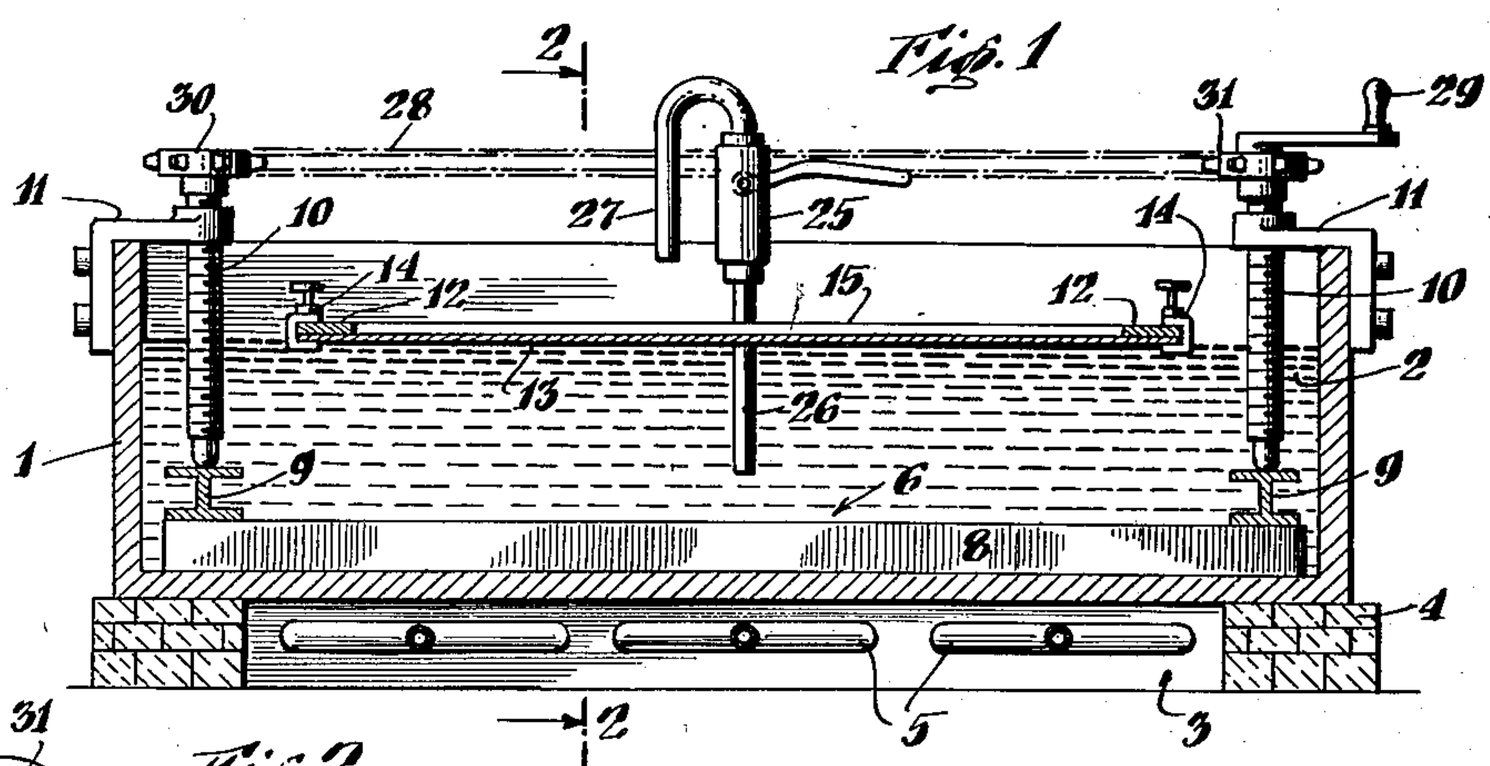


Fig. 2

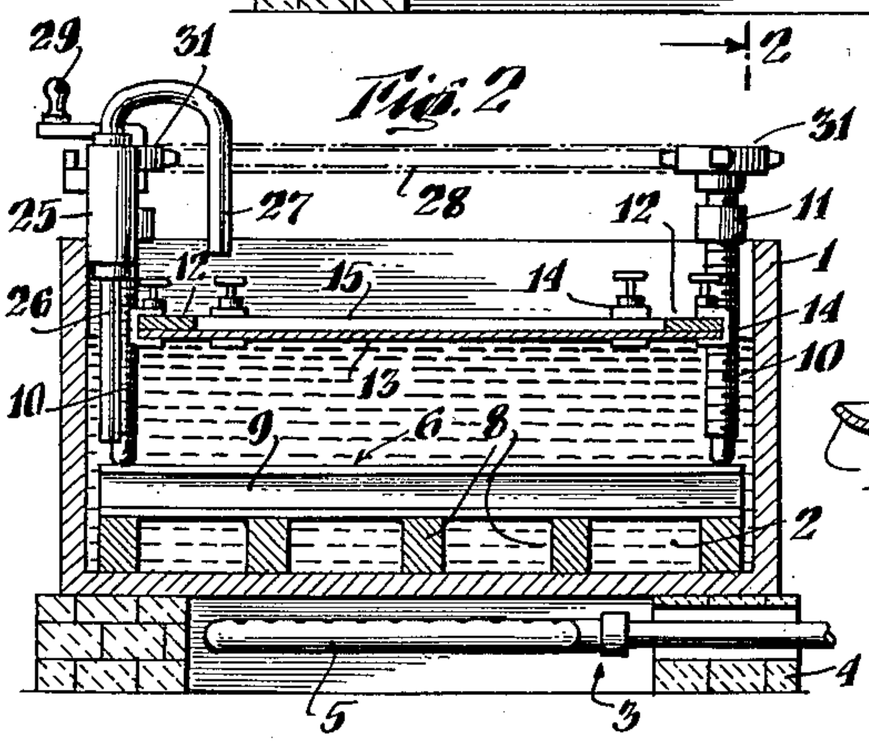


Fig. 4

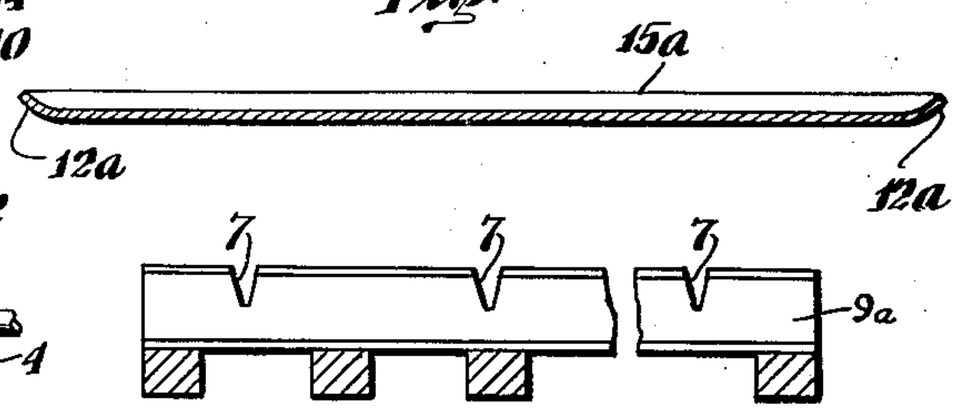
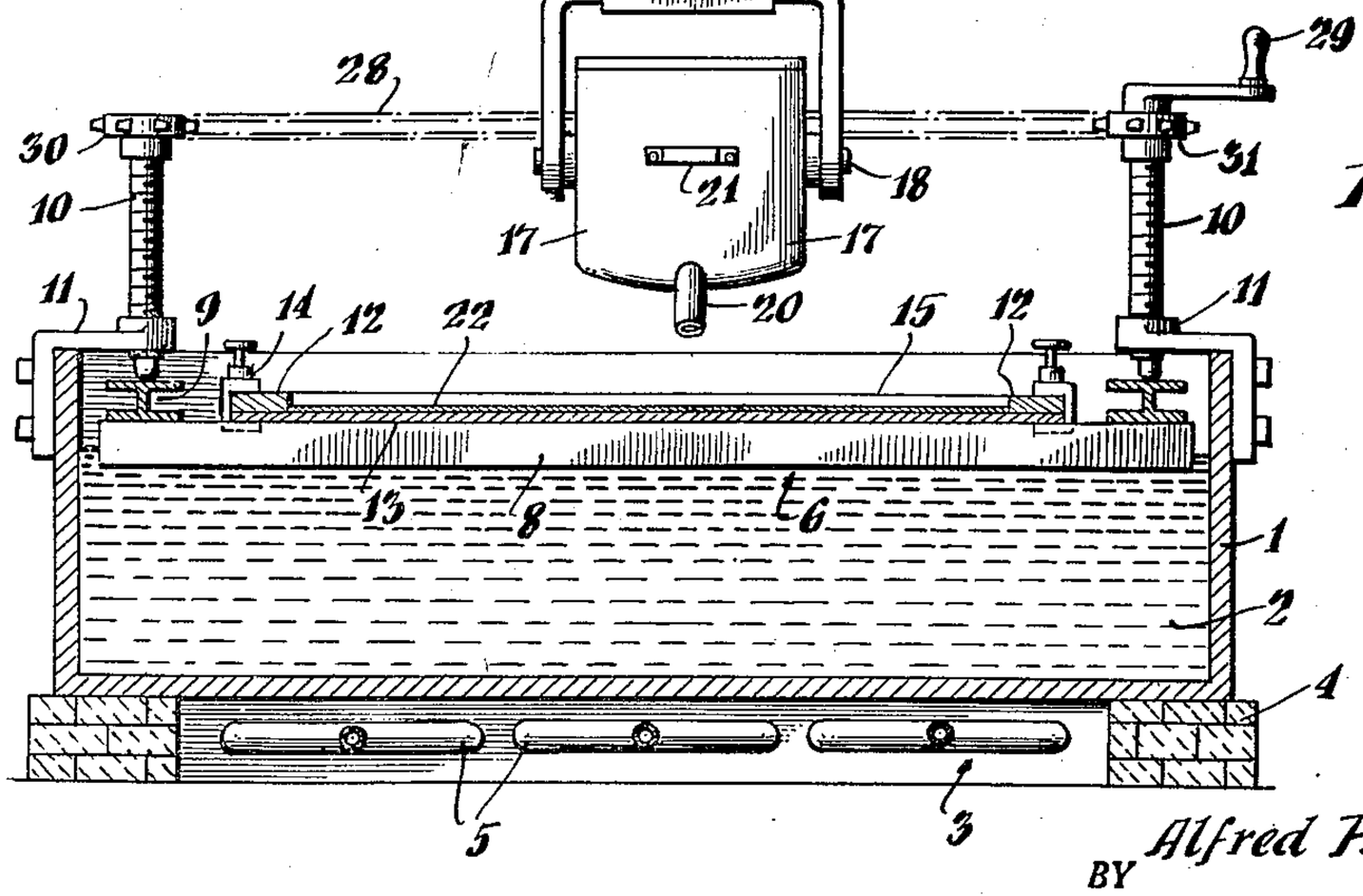


Fig. 5

Fig. 3



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METHOD AND APPARATUS FOR COATING METALLIC OBJECTS

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The present invention relates generally to a method and apparatus for coating metallic objects and more particularly to a method and apparatus for applying lead coatings and linings to steel plates.

Various industrial operations require the use of lead lined containers; chemicals such as acids, for example, are commonly shipped in containers with inert lead linings. Several ways and means have been tried for coating sheets of metal with lead.

Hitherto, this has been accomplished by electrolytic processes but such is costly and objectionable for various reasons. Although it is cheaper and quicker to heat the article to be coated to the melting point of lead and apply molten lead directly to its surface by pouring or dipping, the processes developed in this art heretofore have not proven fully satisfactory.

The most common practice has been to place the sheets to be coated on a flat surface and heat them by gas jets or otherwise until they are at the proper temperature so that molten lead may be coated thereon. When a sheet is heated in this manner, however, it tends to buckle and warp due to the fact that the heat cannot be applied evenly over the entire sheet. As a result the lead when applied is of an uneven thickness, the lining surface comprising a series of hills and dales.

A bath of molten lead has been proposed in which the plate or sheet is immersed and heated, the bath containing the sheet then being allowed to cool and solidify. The lining produced in this manner is not subject to the imperfections referred to previously. However, the process is subject to serious disadvantages in that after the lead mass has solidified, the submerged coated steel sheet can be removed only by cutting it away from the remainder of the hardened bath. Further, immersion of a steel plate coated with bonding material contaminates the lead bath and impairs its usefulness in subsequent operations.

The present invention aims to overcome the above and other difficulties by providing a method whereby steel sheets may be heated uniformly by being floated in a molten lead pool, covered with a coating of molten lead and easily removed from the pool while the latter is molten. At no time need the bonding surface of the steel plate come into contact with the contents of the pool; the same pool may be used for any number of lining operations.

An object of the present invention is to provide an inexpensive and practical method and means for coating metallic objects;

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Another object of the invention is to provide an improved method and means for coating metallic plates with a lead lining which is smooth in texture and uniform in thickness without warping or buckling the plates;

Another object of the invention is to provide a method for coating metallic plates with lead which does not necessitate immersing the plate in a molten lead bath;

A further object of the invention is to provide means whereby a metallic plate may be easily removed from a molten pool after the lining layer has hardened.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein;

Fig. 1 is a sectional view of a preferred embodiment of the invention;

Fig. 2 is a sectional view along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view similar to Fig. 1 showing the lead lining cooling after being applied to the steel sheet and illustrating a different means for applying material to a sheet to be coated;

Fig. 4 is a sectional view of a modified form of sheet to be coated; and

Fig. 5 is a side elevational view of a modified form of raft.

The apparatus described herewith illustrates but one way in which the method disclosed may be practiced. It may be performed in any of several different ways with different apparatus.

Referring to the drawings and more particularly Figs. 1 and 2, there is shown a container 1 adapted to form a lake or pool 2 of molten coating materials. It is to be understood that the lake 2 could be formed by heating a material other than that used in the coating to a molten state. The container may be supported by brickwork 4 which encloses a series of burners 5 to form a furnace 3 that heats said container from underneath. Any suitable heating medium, such as, gas, oil, coal or electricity may be employed.

Although the method and apparatus herein disclosed could be employed equally well in coating any one of a number of metals, as for instance nickel, copper or brass, for convenience

of description let it be assumed that a steel plate is to be lead coated on one side only for subsequent rolling into a lead-lined container.

A raft 6 is provided in the pool 2 of lead, said raft preferably comprising a series of stringers 8 joined together and spaced apart one from the other by transverse ties 9. In the embodiment shown said stringers are cast iron bars welded to transverse I beams 9. They should be positioned so as to provide a level platform for the steel plates which they are to support and be placed sufficiently close together so that the heated plates will not tend to sag into the open spaces between them. Although the raft is made of cast iron in the preferred embodiment, it is to be understood that it could be formed from any material having a specific gravity lower than that of lead, and a melting point higher. The term "raft" is likewise meant to include any float member having a horizontal supporting surface, whether said member comprises a series of units joined together as are the stringers 8 and ties 9 in the preferred form, or whether it comprises an integral structure having one or more buoyant compartments within it.

Since iron is of less density than the lead pool, the raft member normally tends to float on the surface of the pool 2. It may be held beneath the surface of said pool, however, by means of the adjusting screws 10 which are provided fitting in the brackets 11 attached to the rim of the container 1.

Sprockets 30 and 31, secured to the adjusting screws 10, are joined by a chain 28. When handle 29 on the driving sprocket 31 is turned, the sprockets rotate so that the adjusting screws 10 are lowered and raised together and at a uniform rate.

The lower ends of the screws 10 are adapted to bear on the upper surface of the transverse tie members 9 so that when the adjusting screws are lowered the raft member is forced downward toward the bottom of the pool. Fig. 1 shows the raft member fully submerged. When the adjusting screws 10 are raised, the raft member 6 tends to float to the surface of the pool, as shown in Fig. 3.

In operation, a strip of asbestos or other suitable material may be applied to each of the peripheral edges of the plate 13 by clamps 14 as a rim 12 to define the portion of said plate which is to be lined and to form a "vessel" 15 into which molten lead may be poured in a further operation. While this is the preferred method, the same results may be obtained by flanging the edges of the plate upwardly as shown in Fig. 4 to form a raft 15*a* with peripheral side portion 12*a* extending completely about the plate. The plate then may be thoroughly cleansed by pickling in a solution of muriatic acid or sulphuric acid. Any other suitable means, such as steel shot blasting, may be employed alternatively to insure that the surface to be lead coated is chemically clean.

Since lead will not adhere to an untreated steel surface, a bonding material should be interposed between the two metals. This may be done in any of several ways. A solder flux of ammonium chloride, zinc chloride or stannus chloride may be smeared on the plate face to be lined and solder applied over it in a thin coating. The solder will form a bond between the plate and the molten lead to be applied subsequently. Various other methods of providing a bond are known to those skilled in the art.

As a further step, the lead in the container 1 is heated by the furnace 3 to its melting temperature. The raft member 6 tends to float on the surface of the pool 2 in its normal position. The steel plate 13, treated with a bonding material and formed into a vessel 15 as previously described, may be placed on top of the raft member 6 with its treated surface uppermost. The adjusting screws 10 are then lowered against the transverse ties 9, submerging the ties and the raft member in the pool of molten lead until said raft member has assumed the position shown in Fig. 1. With the support of the raft member removed, the steel vessel 15 tends to float on the surface of the pool or lake. It is to be observed that the steel plate 15 would float even without the rim 12 formed by the asbestos strips or by flanges as described above, for the reason that steel is less dense and lighter than lead.

The floating steel vessel 15 may be heated uniformly by the molten lead to the temperature of the pool. The even distribution of heat prevents warping or buckling. When the vessel has attained the temperature of the pool, molten lead is applied to the surface to be coated. In the preferred method a hand pump 25 is used to introduce lead from the pool into the vessel, as shown in Fig. 1. Molten lead may be sucked from the pool through a pipe 26 and forced through an outlet pipe 27. Normally the pump 25 will be held so that outlet pipe 27 is close to the surface of the steel plate 13. The pump may be moved to different positions above said plate during the pumping operation so that molten lead will be distributed evenly over the plate surface to be lined. Inside the vessel the molten lead will form a level of a thickness determined by the amount of lead introduced, said thickness being about level with the height of the peripheral rim 12. An alternative method of applying the coating, as shown in Fig. 3, is by means of a kettle 17 suspended above the pool in a pivotal mounting 18 and slidably movable along an overhead track 19. A plurality of nozzles or spouts 20 pour molten lead onto the surface to be coated below. Even distribution of the lead coating may be achieved by sliding the kettle along the track 19 lengthwise of the plate and tilting it from side to side by means of handles 21 as the lead is poured. A kettle in a fixed position may also be used, preferably with a flexible spout so that the lead can be sprayed over the surface of the plate. A third method is to utilize a long handled instrument resembling a hoe to draw lead from the pool 2 into the vessel 15 over the low peripheral rim 12.

When a coating 22 of the proper thickness has been applied to the plate 13, the adjusting screws 10 may be raised and the raft member 6 allowed to float to the surface, lifting the vessel 15 out of the pool of lead. Since the bottom surface of the vessel has not been treated with a bonding material, lead will not tend to adhere to it. The floating raft provides a level platform on which the lead coating 22 may cool and harden into a lining of even and uniform thickness. The hardening process does not necessitate a reduction in the temperature of the lead pool 2; the vessel 15 is raised completely free from the pool by the raft member 6 and cools sufficiently while on the floating raft so as to harden though the temperature of said pool remains constant.

The raft member 6 with the vessel 15 resting on it may be removed from the pool by a crane or other suitable means, and placed on a hori-

zontal support for further cooling and hardening. As shown, the adjustable screws 10 would of course be moved out of the way before lifting the raft out of the container 1. When cooled to a solid state, the plate may be taken off the raft and the strips 12 of asbestos or other suitable material unclamped from its periphery. The lead lined steel plate is then ready for rolling into containers or similar useful articles.

It will be noted that no matter how thin the steel plate to be lined, it may be raised from the surface of the pool by the raft member 6 and then, still quite hot, removed from the pool area while resting on the raft member, without danger of warping or bending in either operation. In many instances, however, the steel sheet to which the lead is to be applied may be quite heavy, an inch or two thick, and strong enough to withstand deformation while being lifted in a heated state. In such cases the raft member may be dispensed with. The steel sheet may be formed into a vessel, heated by floating on the pool 2, and covered with molten lead by the methods disclosed heretofore. It may then be removed from the pool, a crane or other suitable means engaging it at three or four points and transferring it to a horizontal support for cooling and hardening.

In a modified form, the depth of the lake is not sufficient for the transverse ties 9a (Fig. 5) to be completely submerged. In such case these members are only partly covered by the molten lead. As a result there is a tendency for the lower surfaces of the ties which are submerged to expand, warping and buckling the ties and consequently warping the entire raft member. To overcome this, a series of slots or notches 7 may be provided in the upper surface of the tie. In this way the upper surface of the tie may expand correspondingly to the expansion of the lower surface without deformation of the member.

While the invention has been discussed heretofore only in connection with the lead coating of steel plates, the method and apparatus disclosed herein may be utilized in applying various coatings to objects made of brass, aluminum, copper or other materials.

If it is desired to coat materials which are more dense than the coating material and will not float in the pool or lake, the raft member may be made of a substance which is less dense than the coating material so that it will float and tend to substantially support the object to be lined at all times. During the heating operation, the raft member may be partly submerged by the adjusting screws 10, so that the bottom surface of the object to be coated and part of the peripheral rim 12 tends to be immersed in the pool. After heating has been completed, the plate may be coated, the lining allowed to harden and the raft member removed from the pool in the manner already set forth.

It will be seen that the present invention provides a new and improved method and apparatus for applying coatings to metallic objects quickly and with a minimum of expense. The lining resulting is of an even thickness and has a smooth surface free from warping and imperfections. The lined plate may be removed from the pool while the latter is still molten. The coating or lining process does not contaminate the pool; it may be used immediately for successive coating operations, after removal of the raft therefrom;

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. The method of coating a metallic object which comprises providing a pool of molten material, providing an enclosing rim on said object to form an upwardly exposed surface encircled by the rim for confining coating material thereon, heating the object by floating it on and in direct contact with the pool of molten material with said rimmed surface facing upwardly, applying a coating material to the upwardly exposed surface of the object within the confines of its enclosing rim, and separating the object with its applied coating material from the pool and cooling the same.

2. The method as claimed in claim 1, in which the metallic object is steel and the molten material is lead and the coating material is applied by transferring molten lead from the pool to the upper surface of the steel object and depositing it within the confines of said enclosing rim.

3. The method of coating a metallic object which comprises providing a pool of molten material, securing to said object at least a single strip of material to form an upwardly exposed surface encircled by the strip material for confining coating material thereon, heating the object by floating it on and in direct contact with the pool of molten material with said encircled surface facing upwardly, applying a coating material to the upwardly exposed surface of the object within the confines of said encircling strip material, and separating the object with its applied coating from the pool and cooling the same.

4. The method of coating a metallic object which comprises providing a pool of molten material, providing a confining ridge on said object by turning portions of the object upwardly to form an upwardly exposed surface encircled by the ridge for confining coating material thereon, heating the object by floating it on and in direct contact with the pool of molten material with said encircled surface facing upwardly, applying a coating material to the upwardly exposed surface of the object within the confines of its encircling ridge, and separating the object with its applied coating from the pool and cooling the same.

5. In the method of coating metallic objects, the steps comprising providing a hot molten mass of coating material, floating a raft on the molten mass, placing a metallic object to be coated on the raft with the surface to be coated upward, at least partly submerging the raft so as to float the object on and in direct contact with the molten mass, heating the floating metallic object by the heat of the molten mass, applying coating material to the upward surface of the object, and thereafter raising the metallic object with the coating material thereon out of the molten mass by controllably raising the raft.

6. The method of coating a metallic object which comprises providing a pool of molten material, providing an enclosing rim on said object to form an upwardly exposed surface encircled by the rim for confining coating material thereon, floating a raft on the pool of molten material, placing said object on the raft with the surface to be coated facing upwardly, at least partly submerging the raft so as to float the object on and in direct contact with the pool of molten mate-

rial with said rimmed surface facing upwardly and heating the object from said pool while so floating, applying a coating material to the upwardly exposed surface of the object within the confines of its enclosing rim, and thereafter separating the object with its applied coating material from the pool by raising said raft.

7. An apparatus for coating metallic objects comprising the combination of a container adapted to contain a molten pool of material, means for heating said container and material, a raft within said container having apertures therethrough adapted to float in said molten pool, means for moving said raft down into the container to at least partially submerge it in the molten pool and for controlling the rise thereof in said molten pool, and means having a portion extending above the raft for transferring molten material from said molten pool to a position above said raft.

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