Abstract of the Disclosure

Apparatus for degreasing, phosphatizing and removing acid from treated article has a main tank including vertically spaced heater, imperforate tray, article supporter, sprayers, trough and cooler. The tank contains a treating bath including a volatile solvent, trough conveys solvent condensate to first supplementary tank. Imperforate tray conveys solvent oil condensate to second supplementary tank. Pump and conduit means sequentially deliver treating bath and then solvent condensate from main tank and first supplementary tank, respectively, to sprayers.

This invention relates to machines for treatment of articles to be painted or coated, and has to do with apparatus and a method for conditioning metallic articles for that purpose. Metal articles which are to be painted or otherwise coated should be in a thoroughly clean condition, free of grease and other foreign substances, and preferably should be provided with a conditioned surface of a character to assure adherence of the coating material. It is known to subject such articles to the action of a bath of a degreasing solvent, such as trichlorethylene, containing phosphoric acid and heated to the boiling point, at atmospheric pressure, of the solvent. In such treatment the articles are effectively cleaned and degreased and the surfaces thereof are conditioned by the bath to assure adherence of the coating material. The presence of any acid on the treated articles renders it difficult to obtain a satisfactory coating thereon. That necessitates further treatment of the articles to assure that they are completely free of acid, which results in delay and increased cost.

My invention is directed to a treating apparatus or machine by which articles to be coated may be effectively cleaned and degreased and phosphatized, and all traces of the acid are effectively removed, in a single operation, without objectionable delay and at minimum cost. It is a further object of my invention to provide a machine which may be used for degreasing purposes only, or for both degreasing and phosphatizing with complete removal of acid from the treated articles.

Another object of my invention is to provide a treating apparatus whereby the degreasing and surface conditioning of the articles may be performed in a single substantially continuous operation. Further objects and advantages of my invention will appear from the detail description.

In the drawings:

FIGURE 1 is a top plan view of degreasing and phosphatizing machine embodying my invention;
FIGURE 2 is a side view, partly broken away and in section, of the machine of FIGURE 1;
FIGURE 3 is an end view of the machine of FIGURE 1; and
FIGURE 4 is a fragmentary sectional view, taken substantially on line 4--4 of FIGURE 2, with the deflector member in substantially vertical position and partly broken away, the side walls of the tank being also broken away.

The machine of my invention comprises an open top tank 1 rectangular in plan and having an end extension 2. The tank 1 is, in general, of known type, except as to those features having to do with my invention. The lower portion of the tank 1 provides a support adapted to contain a bath or body of a treating solution and is provided with heating means, conveniently steam coils 3, as is known. An exterior cooling water jacket 4 extends about the upper portion of tank 1, above end extension 2 thereof, and an interior cooling coil 5 extends about the interior of tank 1 in the zone of jacket 4 and extending about the lower. An interior condensate trough 6 underlies coil 5 and delivers condensate to a well 7 at one corner of tank 1, trough 6 being appropriately disposed and inclined to that end. The well 7 is connected by a short conduit 8 to the inlet of a water separator 9. The solvent outlet of separator 9 is connected by a conduit 10 to a distillate or pure solvent storage tank 11 in extension 2 and in part formed thereby, which storage tank is closed to tank 1. The water separator 9 may be of any suitable known type, such as that disclosed in the patent to Edward L. Blakelee, No. 2,223,595, and is provided adjacent its top with a water discharge conduit 12 for conducting the water to a suitable location.

The solvent of the bath, to be referred to more fully presently, is a chlorinated hydrocarbon, preferably trichlorethylene, which is heavier than water. The distillate which enters the water separator 9 sinks below the water therein and flows into tank 11, the water being discharged from separator 9 adjacent the top thereof. The water present in the distillate is due to moisture absorbed by the solvent vapor from the atmosphere and should be removed to assure efficient operation of the machine or apparatus, as is known.

An imperforate flat tray 15 is removably supported on cross rods 16 extending between the side walls of tank 1 and is inclined downwardly toward an open top tank 17 in extension 2 and underlying tank 11 in spaced relation thereto. The tray 15 is of slightly less length and width than the interior of tank 1, is provided with upwardly extending side flanges 15A and an upwardly extending end flange 15B and its other end is open and spaced inwardly a short distance from and above the inner side wall of tank 17. A gate valve or deflector member 18, of elongated U-shape, extends into the interior of tank 1 between the inner side of tank 17 and the adjacent end of tray 15, the latter being restrained against movement toward tank 17 by abutment elements 16A on the under face of tray 15 disposed to contact cross rods 16. The gate valve 18 is secured at its midpoint to a cross rod 18A pivoted in brackets 18B fixed to the side walls of tank 1, for adjustment to either one of two positions optionally. In one of its positions, indicated in broken lines in FIGURE 2, it underlies the adjacent end of tray 15 and overlies the inner portion of tank 17 and is then effective for directing liquid into the latter from tray 15. In its other position, shown in full lines, deflector 18 extends downward across the end of tray 15 and is then effective for directing liquid therefrom into the sump of tank 1 underlying tray 15.

The desired adjustment of deflector 18 may be effected in any suitable manner. Conveniently a crank handle 19 is secured on the outer end of a stub shaft 19A rockably mounted through side wall 1a of tank 1 and is held in adjustment by a cooperating rack 20 secured to that wall. An arm 21, secured on the inner end of stub shaft 19A, is connected by a rod 22 to an arm 23 fixed on cross shaft 18A between deflector 18 and side wall 1a. The crank handle 19 and associated parts provide convenient means for adjusting deflector 18 to either of its two positions and holding it in adjusted position, as will be understood. Suitable heating means, conveniently steam coils 24, is mounted in tank 17. 1 also provide suitable means for
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3. circulating steam through the coils 3 and 24 and coolant, usually cold water or brine, through the water jacket 4 and the cooling coil 5, as is known.

In practice the sump of tank 1 contains a body or bath of molten phosphating solution. The bath preferably comprises the following ingredients in the proportions stated—approximately 920 pounds of a product sold under the trade name of "Triclene-L," approximately 160 pounds of a product sold under the trade name of "Triclene-R" and approximately 1.5% by weight of a phosphoric acid solution known as 85% N.F. The two products "Triclene-L" and "Triclene-R" are produced and sold by E. I. du Pont de Nemours and Company, of Wilmington, Delaware, under the trade names stated, and are well known and extensively used in phosphating operations. Each of such products is comprised largely of triethylene. In practice "Triclene-L" is added to the bath to replace evaporative losses and phosphoric acid solution is added, as required, to maintain the concentration thereof at the desired value. The relative amounts of the constituents of the bath may be varied, within permissible limits, as will be understood.

In operation the bath is heated to the boiling point of the solvent thereof, assumed to be trichloethylene, approximately 188° F. at atmospheric pressure. The other constituents of the bath are not volatile and the space between the surface of the bath and the cooling coil 5 becomes filled with pure solvent vapor the upper surface of which is determined by the cooling coil 5 and water jacket 4, which preclude escape of the vapor to atmosphere through the open top of the tank 1. The articles to be treated are immersed, at room temperature, in the relatively hot solvent vapor of the zone above the tray 15. Consequently the articles rest upon the flat 13 or other suitable supporting means spaced above tray 15, but may be supported in any suitable manner. The solvent vapor condenses on the relatively cold article and dissolves any oil or grease present thereon, the resultant solvent-oil solution dripping from the article onto the tray 15 and carrying off with it any particles of insoluble materials which may be present on the articles. The solvent oil solution is directed from the tray 15 into tank 17 by the gate valve or deflector 18, then in its broken line position of FIGURE 2. The articles are then in a thoroughly clean and oil-free condition. The solution, passing through the bath solution projected from upper and lower spray pipes 25 mounted within tank 1, at the sides thereof between cooling coil 5 and tray 15. The pipes 25 are connected by valve controlled conduits 26 to the discharge of each pump 27. The pumps 27 are driven by an electric motor 28 and having its intake connected by a valve controlled conduit 28a to the bath in the sump of tank 1. At the start of such spraying operation the gate valve 18 is turned to its full line position of FIGURE 2, and the solution flows back into the sump of tank 1. The spraying of the solution onto the articles continues for a predetermined time, usually rather short, until the surface of the article has been properly conditioned. The time required for that varies, depending upon the material and condition of the article, but is readily determined by experience. When the article has been sprayed sufficiently with solution taken from the sump of tank 1 the pump 27 is stopped. The article is then sprayed with the pure solvent, projected from spray pipes 29 mounted in tank 1 at the sides thereof, between the bath solution spray pipes 25, with the gate valve 18 remaining in its full line position effective for the spraying the solvent into the sump of tank 1. The pure solvent is delivered to spray pipes 29 by a rotary pump 30 driven by an electric motor 31 and having its intake connected by a valve controlled conduit 32 to the pure solvent or distillate tank 11 and its discharge connected by valve controlled conduits 33 to spray pipes 29. The solvent-spray solvent-phosphoric acid from the articles which are then withdrawn from the tank 1 and rapidly dry by evaporation of the solvent. The article is then in a thoroughly cleaned condition with an etched surface to which a coating of paint or other suitable material will readily adhere. When the pure solvent distillate from tank 11 is not being sprayed upon the articles, any excess distillate in tank 11 is returned to the sump in main tank 1 through a valve controlled conduit 35. In that manner the solvent of the bath is replenished and the distillate in tank 11 is maintained at a substantially constant level when the articles are not being sprayed therewith.

As previously noted the constituents of the bath other than trichloethylene are not volatile. Also, the grease and oil and other substances removed from the articles by the solvent vapor and directed into the tank 17 are not volatile. Accordingly, heating of the solvent-oil slurry while the machine of my invention may be provided with the usual accessories including thermometers, gauge glasses etc., as is known, which need not be described here. Also, if desired, the gate valve 18 may be power operated and automatically controlled by suitable known means and the pumps 27 and 30 may be automatically controlled by timers of suitable type, in a known manner. Further, by providing appropriately arranged conduits and valves, the pumps 27 and 30 may be replaced by a single pump, in a known manner.

The machine of my invention may be provided with the usual accessories including thermometers, gauge glasses etc., as is known, which need not be described here. Also, if desired, the gate valve 18 may be power operated and automatically controlled by suitable known means and the pumps 27 and 30 may be automatically controlled by timers of suitable type, in a known manner. Further, by providing appropriately arranged conduits and valves, the pumps 27 and 30 may be replaced by a single pump, in a known manner.

As indicated my invention is directed to surface conditioning of articles formed of various metals or other materials analogous to metals in respect to surface conditioning preliminary to application of a coating of paint or other suitable substance. It will be understood that the phosphating solution above described and shown by way of example only and that any suitable known phosphating solution may be used. It may be assumed, for example, that the article to be surface conditioned, is formed of steel and that the phosphating solution used is "Triclene-L". At all traces of phosphoric acid from the article will have a surface film of iron-phosphate which is etched by the phosphoric acid to an extent providing "teeth," i.e., a roughened
The coating of paint or analogous material will adhere tightly to the iron-phosphate and to the roughened surface thereof provided by the etching etch for phosphoric acid. If the article to be surface conditioned is formed of zinc or has a zinc covering, resulting from galvanizing for example, the phosphating solution will produce on the treated article a film of zinc phosphate which is etched by the acid and to which a coating of material will tightly adhere. In its broader aspects, my invention comprehends the treatment of articles formed of any suitable material and the use of any suitable known phosphating solution or the equivalent thereof.

As above indicated, and as will be understood, changes in detail may be resorted to without departing from the field and scope of my invention, and I intend to include all such variations, as fall within the scope of the appended claims, in this application in which the preferred form only of my invention is disclosed.

I claim:

1. In article treating apparatus, a main tank substantially rectangular in plan and providing at its lower portion a sump for a treating liquid bath containing a volatile solvent, means for heating the bath to approximately the boiling point of the solvent at atmospheric pressure, an imperforate tray in said tank spaced from the walls thereof and inclined downwardly toward one end wall of said main tank, spray means extending into said tank above said tray, means for conveying solvent condensate liquid from said tray into said second supplementary tank and said sump optionally, means for heating the liquid contents of said second tank to approximately the boiling point of the solvent at atmospheric pressure, and means for selectively delivering liquid bath from said sump and solvent condensate from said first supplementary tank to said spray means under pressure.

2. In article treating apparatus, a main tank substantially rectangular in plan and providing at its lower portion a sump for a treating liquid bath containing a volatile solvent, means for heating the bath to approximately the boiling point of the solvent at atmospheric pressure, an imperforate tray in said tank spaced from the walls thereof and inclined downwardly toward one end wall of said main tank, spray means extending into said tank above said tray, means for conveying solvent condensate liquid from said tray into said second supplementary tank and said sump optionally, means for heating the liquid contents of said second tank to approximately the boiling point of the solvent at atmospheric pressure, and means for selectively delivering liquid bath from said sump and solvent condensate from said first supplementary tank to said spray means under pressure.

3. In article treating apparatus, a main tank substantially rectangular in plan and providing at its lower portion a sump for a treating liquid bath containing a volatile solvent, means for heating the bath to approximately the boiling point of the solvent at atmospheric pressure, an imperforate tray in said tank spaced from the walls thereof and inclined downwardly toward one end wall of said main tank, spray means extending into said tank above said tray, means for conveying solvent condensate liquid from said tray into said second supplementary tank and said sump optionally, means for heating the liquid contents of said second tank to approximately the boiling point of the solvent at atmospheric pressure, and means for selectively delivering liquid bath from said sump and solvent condensate from said first supplementary tank to said spray means under pressure.

4. In article treating apparatus, a main tank substantially rectangular in plan and providing at its lower portion a sump for a treating liquid bath containing a volatile solvent, means for heating the bath to approximately the boiling point of the solvent at atmospheric pressure, an imperforate tray in said tank spaced from the walls thereof and inclined downwardly toward one end wall of said main tank with its lower end spaced from said one end wall, spray means opening into said tank above said tray, means for conveying solvent condensate from said first supplementary tank to said spray means under pressure.

5. In article treating apparatus, a main tank substantially rectangular in plan and providing at its lower portion a sump for a treating liquid bath containing a volatile solvent, means for heating the bath to approximately the boiling point of the solvent at atmospheric pressure, an imperforate tray in said tank spaced from the walls thereof and inclined downwardly toward one end wall of said main tank with its lower end spaced from said one end wall, spray means opening into said tank above said tray, means for conveying solvent condensate from said first supplementary tank to said spray means under pressure.

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