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2,943,797

APPARATUS FOR TREATING SURFACES

Filed June 4, 1956

2 Sheets-Sheet 1

FIG. 1.

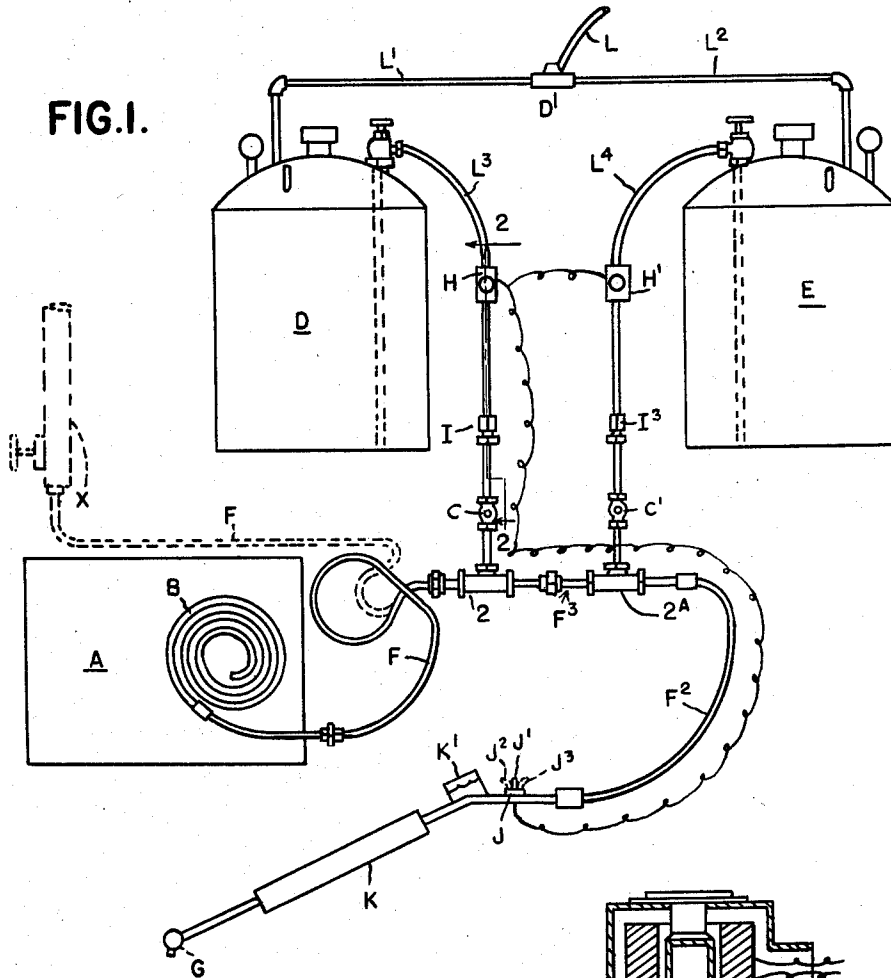
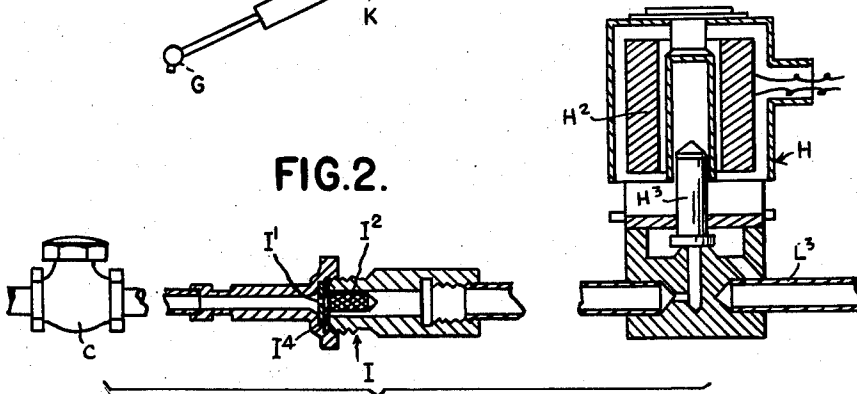


FIG. 2.



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APPARATUS FOR TREATING SURFACES

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4 Claims. (Cl. 239—305)

The invention relates to apparatus for treating surfaces preparatory to the coating of the same with paint, enamel or other materials. The invention is a continuation-in-part of my application Serial No. 484,960, filed January 31, 1955.

It is the object of the invention to simplify the apparatus required for the cleansing and phosphating of surfaces prior to final coating, and thereby reduce the cost of processing. The invention in its broader aspects therefore consists generally in means for generating a hot fluid carrier stream and delivering it to a nozzle from which it is forcefully discharged against and over the surface to be treated, together with means for selectively injecting the treating agents into said carrier stream in advance of its discharge from the nozzle. More particularly the invention consists in an apparatus by which the discharged stream simultaneously cleans and phosphates so that as soon as the surface is sufficiently cleansed, it is also phosphated substantially at the same time. The invention further consists in various features of construction as hereinafter set forth.

In the accompanying drawings:

Fig. 1 is a diagrammatic representation of my improved apparatus.

Fig. 2 is a view partly in section on line 2—2, Fig. 1, on an enlarged scale showing the means for injecting a proportionate quantity of treating material into the main fluid stream.

Fig. 3 illustrates a modified form of the apparatus shown in Fig. 1.

Fig. 4 is a further modification for introducing the treating materials prior to the hydro steam chamber.

As heretofore practiced either a series of dip tanks were used into which the metal was dipped or a series of automatic spray stages were provided through which the articles treated were passed on a conveyor line.

With the dip method although the liquid treating material gets underneath seams, in corners and spots and areas difficult of access, it becomes entirely necessary to depend on the chemicals themselves to dissolve the greases, etc., yet often does not remove them entirely. No pressure or mechanical assistance is exerted in a still dip sufficient to help remove the dissolved or partially dissolved greases from the seams, corners and points of difficult access. As a result this often ends in poor or no phosphate coating at all, and because of this, while the paint is baking in the oven, partially dissolved greases will melt and run out from behind the seams causing paint deterioration or failure.

In the case of the spray method the same condition to some extent exists. The spray jets being on either side of the article may have to be placed too far away from spots, corners, seams or areas difficult of access to exercise the pressure necessary to perform the proper function.

In each of the above methods a large number of successive steps are required to prepare the surface of metal articles in the overall phosphating treatment.

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Usually these steps involve subjecting the surface of the metal to the action of an individual treating agent followed by rinsing of this surface to prepare it for receiving the subsequent phosphate coating material. After receiving the phosphating material it is again rinsed and receives a fifth step, usually a chromic acid bath. Often in the procedure an extra rinse or sixth step is required.

I have discovered that this succession of a large number of distinct steps or operations is unnecessary and that these steps may be reduced generally to two steps, without detriment to the final result, although occasionally three may be preferred. I have also discovered that my apparatus may be used for each of these steps without change or complex adjustment thereof.

I have also devised a very simple and inexpensive construction of apparatus which may be operated manually or electrically and which is particularly adapted for use in establishments having a limited volume of work, floor space or other facilities.

I have found that the use of steam, or steam combined with hot water to which various chemicals may be added is very desirable and even essential in the removal of grease and other foreign matter preparatory to and in the phosphating of metal. The pressure and extreme heat it develops makes it ideal for use in my invention to penetrate under seams and corners and areas otherwise difficult of access. The extra heat also increasingly activates the phosphating chemicals where desired.

In my invention steam or steam combined with hot water is essential. When available in sufficient quantity and pressure from factory boilers, it would be an ideal source of supply. However, a very large number of potential users of my system do not have this convenience. Nevertheless, steam or steam combined with hot water supplied in sufficient pressure and volume is available by using electric steam generators or stationary and portable gas fired, or fuel oil fired or kerosene fired steam generators. These steam generators provide an almost unlimited source of steam supply at low capital outlay and economical operative cost. These steam generators bring the water from room temperature to the steam producing point as quickly as two minutes. Using a portable source of steam or hot water generators, it is practical to make my whole process portable on a small truck capable of being transported to any part of a factory or yard and ready for operation in a matter of five or ten minutes.

The use of compressed air in operating pressure tanks or air pumps is utilized in my invention. Steam pressure itself could be utilized for the same purpose, the principle here being to force under pressure into the steam and water stream when desired, an even flowing and constant uniform amount of treating agent. Thus, other types of pumps capable of fulfilling this principle could be used.

Referring to Fig. 1, the source of steam and water supply may be either a steam pipe X leading from factory boilers or A, which is a water heater and steam generator capable of developing considerable pressure. The steam generator, as specifically shown includes a heating coil B and a gas or other fuel fired furnace surrounding the same, being of sufficient capacity to heat water from its normal temperature to its boiling or steam producing point on its passage through the coil. The source of steam might likewise be generated by an electric steam generator.

D and E are pressurized tanks for containing treating agents which can be forced by pressure into the steam line.

F is a discharge conduit leading from the source of steam or steam and water supply to a discharge nozzle G via a conduit section F³, a flexible conduit F², and a gun K. The conduit section F³ is composed of suitable pipe fittings through which the steam passes. The phos-

phatizing or other chemicals contained in tanks D and E may be alternately injected into the stream through the fittings 2 and 2A respectively, or the chemicals from both may be cut off.

It is desirable that the treating materials injected into the main steam and hot water stream should be quite accurately proportioned thereto, so as to not only obtain the best effect in cleaning the surface of the articles over which the stream is discharged, but also to obtain the necessary chemical reaction on the metal itself in order to produce a phosphate coating or other treatment of the metal as desired. This usually requires accurate proportioning.

This result is obtained, first, by forcing the main steam and hot water stream through the conduit F and F² to the nozzle G at a constant rate; second, by controlling the discharge from the pressure tanks D and E, or air pumps so as to also flow at a constant rate which is proportionate to the rate of flow of the steam and hot water. The means for controlling the rate of flow from the pressure tanks D and E comprises compressed air line direct to pressure tanks or air pumps preferably by compressed air line L to air regulator D'. From D' by conduits L¹ and L² to pressure tanks D and E and from the tanks D and E by conduits L³ and L⁴ leading from their respective tanks and connecting into conduit F³. The conduit L³ from tank D leads through control valve H, flow regulator I, and check valve C to fitting 2 in conduit section F³ of the steam line. The conduit L⁴ leads from tank E through control valve H', flow regulator I³, and check valve C' to fitting 2A in conduit section F³ of the steam line. Fig. 2 illustrates in more detail the control valve H and flow regulator I, both being shown in section. Fig. 2 also illustrates a side view of the check valve C. The control valves H and H' are preferably electromagnetically operated by solenoids controlled by an electric switch J mounted on the gun adjacent to the handle K¹. As shown in Fig. 2, the valve H is connected into the fluid line L³. A solenoid H², when energized, magnetically moves the armature H³ thereby opening the valve and allowing fluid to pass through conduit L³ to the regulator I and then into the steam line.

The flow control device I (see Fig. 2) includes preferably a metal disc I⁴ having a minute opening I¹ therethrough of a small diameter, such for instance as a diameter of .030 of an inch. A strainer I² is arranged adjacent the opening or orifice I¹ of the metal disc I⁴ to remove any substances from the liquid which might obstruct or restrict the regulating function of the calibrated orifice I¹. The check valve C between the flow control device I and the steam line prevents the steam and water being forced back through the conduit L³ to the tank D at any time.

An electric switch J located on the gun K near the handle K¹ controls the electric circuits leading to the solenoid valves H and H¹ respectively. The switch has a neutral position J' (shown in solid lines on Fig. 1) in which both of the solenoids of said valves H and H' are deenergized. The switch also has positions J² and J³ (shown in dotted lines on Fig. 1) on opposite sides of the neutral position J' for respectively energizing one or the other of the solenoids in said solenoid valves H and H'. Such a 3-position electric switch is ordinarily termed a single pole, double throw switch.

The treating agents in tank D effect both the cleaning of the surface of the metal and the phosphatizing of the said surface. Various compositions may be used for this purpose, but I prefer using the mono-phosphate of the group of ammonium, sodium and potassium, together with surface activating agents and molybdic acid. Generally alkali salts of molybdic acid may also be substituted in place of the molybdic acid. A water miscible oil solvent or oil solvent may also be added if necessary. These water soluble oil solvents may be selected from a group of substances, such as the ethers of ethylene glycol,

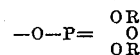
di, tri, and tetra ethylene glycol and its ethers, the methyl and propyl ethers of propylene glycol and the ethers of di and tri propylene glycol. While this treatment alone effects the phosphatizing of the surface, in order to insure perfection and long life in the phosphatizing and coating thereof, I may subject the metal to a second treatment with the fluid from tank E. This fluid includes a solution of chromic acid alone or a solution of phosphoric and chromic acid which has the effect of converting any water soluble or unstable ferrous compounds into insoluble and stable ferric compounds. It also passivates any discontinuity in the coating. The specific formulas preferably used in containers D and E are as follows:

Stock solution for tank D

Mono-ammonium phosphate..... 27 oz.

Surface activating agent of an alkyl phosphate type of the general formula:

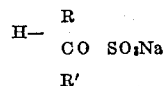
Medium chain alkyl group



(R=water solubilizing group)

A specific of the above formula is "Tergitol."

Surface activating agent consisting of a water solution of a sodium salt of an acid sulphate of multiple carbon saturated branched chain, secondary alcohol, such salt having the general formula:



in which R and R' represent aliphatic hydrocarbon radicals, R plus R' containing a total number of carbon atoms ranging from 6 to 17.

A specific of the above formula is "Victowet."

Sodium molybdate..... 1 oz.
Mono ethyl ether of ethylene glycol..... 250 cc.
Monobutyl ether of ethylene glycol..... 500 cc.
Water..... 5 gal.

Stock solution for tank E

5 lbs. phosphoric acid.....
3½ lbs. chromic acid..... } Base solution.
2 lbs. water.....

After dissolving add enough water to make one gallon. For working solution for tank, use one-half pint of above to six gallons of water.

With the apparatus and materials as above described the process is carried out as follows:

If the metal to be cleaned consists of sheet metal pieces, they may be carried on a conveyor or placed against a wall, so that a considerable square footage may be treated at a time, or if, an article such as an automobile body, it may be allowed to sit on the floor.

A constant stream of steam and hot water is supplied from the nozzle G. The operator directs the stream from the nozzle G against the surface of the work; at first up close to the metal so as to allow the steam pressure to assist in getting the liquid under seams and into points difficult of access. The operator adjusts the switch J so as to inject the material from the tank D into the flowing stream, this having the immediate effect of dissolving and removing grease and dirt from the surface of the work. The stream is continued on the surface of the work to keep it wet with the solution for a matter of a minute or longer in order for the phosphating solution to react chemically on the metal itself and thus build up a phosphate coating. When the articles are sufficiently treated the operator adjusts the switch J to cut off the material from tank D and adjusts the switch to inject material from tank E. This, as above stated will provide the chromic treatment so as to convert undesirable unstable ferrous compounds into stable ferric compounds and passivate any discontinuity in the coating.

It will be understood that the cost of this apparatus is very low, including only that of the tanks D and E, the conduits F, F², F³, and the gun K and nozzle G, the check

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valves, the flow control valves, and the solenoid valve, and in case factory boiler steam is not available, gas fired, kerosene or fuel oil fired steam cleaners or electric steam generators would be used.

In Figure 3 the discharge conduit F for the hot stream is derived from a mixing device M fed from the steam line X and a cold water line N. The pressure from steam line X may be reduced to a predetermined amount by steam regulator R before entering the mixing tank M. Water from the line N passes through a shut-off valve N' and is regulated by the metering means N² before entering the mixing tank M through conduit N³.

A further modification is shown in Fig. 4 and is recommended particularly for hard water areas where frequent and severe restrictions are encountered. In this arrangement the chemical treating materials are introduced into the water line prior to the mixing of the water and steam in the mixing device M. The water conduit N has therein a shut-off valve N¹, and a metering means N² for regulating the amount of water passing through the pipe N³ into the conduit section F³. The conduit L⁴ leading from the tank E containing the chromic acid solution is connected to the water line at N⁴. The conduit L³ leading from the tank D containing the phosphating solution is connected to the water line at N⁵. The water line then enters the mixing device M at N⁶. The discharge conduit O leading from the mixing device M is connected to the flexible hose F² and in this conduit there is a strainer O'. The mixing device obtains a hot stream of the desired consistency by reason of the metering orifice N² and a steam regulator R by means of which the factory steam line pressure may be reduced to a predetermined amount, e.g. 30-40 p.s.i.

The operation of the modified construction of Figs. 3 and 4 is essentially the same as that in Fig. 1 with the added advantage that the mixing device M is easier to regulate to obtain the best proportion of dry steam and water for effective cleaning and phosphating. There is the added advantage to the construction of Fig. 4 that when the treating agents are introduced prior to the mixing device M, all lines have been found to keep cleaner and freer of restrictions for a longer time. The fact that the chromic acid preparation is circulated through the mixing device tends to eliminate the deposits

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which would otherwise build up in lines due to the chemical agents in the hard water.

What I claim as my invention is:

1. Apparatus for chemically treating metal surfaces to apply an adherent phosphate coating which comprises a delivery conduit terminating in a manually dirigible discharge nozzle for directing the stream flowing therefrom against and over the surface of the metal, a steam supply conduit connected to said delivery conduit for introducing a constant uniform flow of steam, a plurality of auxiliary supply conduits connected to said delivery conduit between said steam supply and said nozzle, a separate chemical-containing tank for each auxiliary conduit, a pre-set metering device between each chemical tank and said delivery conduit, a separate closable supply valve for each auxiliary conduit and means manually operable from said manually dirigible discharge nozzle for remotely operating each of said supply valves to thereby selectively deliver the chemicals from each tank into said stream in exact predetermined proportions.

2. Apparatus as in claim 1 in which said hot fluid stream in said delivery conduit is obtained from a mixing tank provided with two separate inlet conduits connected to said steam supply conduit and a source of water respectively, and the means for introducing the said different treating agents is between said mixing tank and said nozzle.

3. Apparatus as in claim 1 in which said hot fluid stream in said delivery conduit is obtained from a mixing tank provided with two separate inlet conduits connected to said steam supply conduit and a source of water respectively, and the means for introducing the said different treating agents is connected to said source of water in advance of said mixing tank.

4. Apparatus as in claim 1 having a mixing tank intermediate said steam supply and said delivery conduit and a separate metered water supply connected to said mixing tank.

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